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THE SIXTH PACIFIC SCIENCE CONGRESS

By Professor ROY ELWOOD CLAUSEN

UNIVERSITY OF CALIFORNIA; SECRETARY-GENERAL OF THE SIXTH PACIFIC SCIENCE CONGRESS

THE sessions of the sixth Pacific Science Congress were held in the San Francisco Bay region from July 24 to August 12, 1939. The University of California, Stanford University and the Golden Gate International Exposition acted jointly as hosts to the congress. Most of the technical sessions were held either at the University of California or at Stanford University, but many of the social functions and public lectures were held at the Golden Gate International Exposition on Treasure Island.

The sixth Pacific Science Congress was organized under the auspices of the National Research Council, specifically under the general supervision of its Committee on Pacific Investigations, of which Dr. Herbert E. Gregory is chairman. The details of organization of the congress, however, were delegated to a local committee, the Committee on the Sixth Pacific Science Congress, with Dr. C. B. Lipman, of the University of California, as chairman; Dr. Roy E. Clausen, of the same institution, as secretary, and with representatives of Stanford University, the University of California and the Golden Gate International Exposition as members. Dr. Ross G. Harrison, chairman of the National Research Council, was president of the congress, and Dr. Roy E. Clausen, secretary-general. Dr. Frank R. Lillie, retiring president of the National Academy of Sciences, was honorary chairman; Dr. Robert Gordon Sproul, president of the University of California; Dr. Ray Lyman Wilbur, president of Stanford University, and the presidents of previous congresses were honorary vice-chairmen.

The sixth Pacific Science Congress was the first meeting of the Pacific Science Association to be held on the mainland of the United States of America.

The fifth congress was held at Victoria and Vancouver in 1933, and in the normal course of events, the sixth congress would have been held at some far eastern center; in fact, provisional arrangements had been made to hold it in French Indo-China, but unfavorable circumstances prevented the fulfilment of these plans. In this predicament, it seemed desirable to take advantage of the Golden Gate International Exposition, with its emphasis on Pacific relations and cultures, to continue the series. Accordingly, arrangements were made rather hurriedly to convene the sixth congress in the San Francisco Bay region during the time of the exposition.

Despite the short time available for preparation and the unsettled conditions, the sixth congress drew a small but representative attendance from countries of the Pacific region. The registered attendance at the congress was 492, about the same as that of the fifth congress, and twenty-eight countries were represented. Attendance at the congress was particularly satisfactory in view of the almost continuous procession of meetings in the San Francisco Bay region during the past summer. In a number of instances, when other meetings occurred concurrently, arrangements were made for joint sessions or for informal cooperation, without the requirement of registration for the congress, which no doubt contributed materially to the gratifying attendance at the technical sessions. Thus the tenth annual meeting of the Western Branch of the American Public Health Association was held in Oakland from July 23 to 28, 1939. Sessions of the section on public health and nutrition were arranged so as to permit participation by their membership, and abstracts of the papers to be presented in this section were made available to them. Similarly, the summer meetings of the Geological Society of America, the Paleontological Society, the Seismological Society of America and the Society of Economic Geologists were held in Berkeley from August 8 to 10, 1939. The sessions of the section for geophysics and geology of the congress were held in the previous week, in order to permit members of the congress to join in their activities. By special arrangement, members of the congress were also permitted to participate in a number of excursions organized for members of these societies. The Oceanographical Society of the Pacific suspended its usual summer meeting in order to cooperate fully with the section on oceanography, fisheries and marine biology.

PUBLICATIONS

Before the congress opened, a number of announcements containing various kinds of information about the congress were circulated to a mailing list made up of institutions and organizations having some interest in the Pacific area and of individuals from lists obtained from section chairmen and other sources. The first of these, a preliminary announcement, setting forth the general purposes of the congress and outlining its organization, was issued in January, 1939. A second, supplementary announcement, containing chiefly a tentative outline of the program and the names and addresses of section chairmen, was issued in March. Finally, an advance announcement, containing information about accommodations, a detailed outline of the program, etc., was issued in June.

On registration, members received a copy of the General Program, a booklet of 160 pages, containing general information about the congress and full details of the technical sessions, including names of authors and titles of papers to be presented. They also received, on request, mimeographed sets of abstracts of the sections in which they were interested, as well as other miscellaneous material designed to acquaint them with some of the features of the San Francisco Bay Region and with activities and events in progress during the meeting. Ten sets of abstracts were issued; *viz.*, Geophysics, Pre-Tertiary Geology, Tertiary Stratigraphy, General Geology, Oceanography, Fisheries and Marine Biology, Pacific Climates Past and Present, Anthropology, Epidemiology, Industrial Hygiene and Nutrition.

As with previous congresses, the general records of the congress and the papers presented in its sessions will be published in a set of volumes under the title, "Proceedings of the Sixth Pacific Science Congress," which will be distributed by sale and subscription only. Copies of the General Program may be obtained, as long as they are available, on request to the Secretary-General, 205 Hilgard Hall, University of California, Berkeley, California.

THE INAUGURAL SESSION

The formal opening of the congress was held on July 24, at the University of California. At the inaugural session, Dr. Herbert E. Gregory, president of the first congress and chairman of the Committee on Pacific Investigations of the National Research Council, introduced the president of the congress, Dr. Ross G. Harrison, chairman of the National Research Council. Messages of welcome were extended in behalf of the host institutions by Dr. Ray Lyman Wilbur for Stanford University and the Golden Gate International Exposition, and by Dr. Monroe E. Deutsch for the University of California. A message to the congress from Dr. Frank R. Lillie, retiring president of the National Academy of Sciences, was read, and the president of the congress delivered an address of welcome to the visiting delegates. Responses to the address of welcome were made by representatives of fourteen countries.

BUSINESS SESSIONS

The congress held two plenary sessions for a consideration of business matters, the first dealing with organization of the congress and the second with matters referred to it by the Pacific Science Council, the executive committee of the Pacific Science Association. The council consists of one representative each from fourteen countries included in the Pacific region or having dependencies therein. For the present congress its membership consisted of Ross G. Harrison (United States of America), *chairman;* E. C. Andrews (Australia); R. C. Wallace (Canada); Y. R. Chao (China); Jules Rouch (France and French Indo-China); V. H. Blackman (Great Britain); C. Montague Cooke (Hawaii); Shinkishi Hatai (Japan); H. A. Brouwer (Netherlands); H. J. Lam (Netherlands Indies); Patrick Marshall (New Zealand); Walfrido de Leon (Philippine Commonwealth); and H. E. Gregory (United States of America). R. L. Pendleton (Thailand) was present by invitation, and only the Union of Socialist Soviet Republics was not represented.

THE SEVENTH CONGRESS

The congress accepted an invitation extended by the Commonwealth of the Philippines to hold the seventh congress in Manila in 1943. In the absence of any permanent secretarial staff for the Pacific Science Association, informal arrangements were made to have Dr. Patrocinio Valenzuela, secretary of the National Research Council of the Philippines, act as interim secretary of the association for the period between the sixth and seventh congresses.

STANDING COMMITTEES OF THE PACIFIC SCIENCE ASSOCIATION

The council gave special attention to the reorganization of its standing committees, looking towards more effective activity in the intervals between congresses. The list of committees and their chairmen, as approved by the congress, follows:

Oceanography: Dr. Thomas G. Thompson, University of Washington, Seattle, Washington.

Protection of Nature: Dr. Carl Skottsberg, Botanic Gardens, Gothenburg, Sweden.

Volcanology: Dr. Patrick Marshall, Public Works Department, Wellington, New Zealand.

Soil Survey and Classification: Dr. R. L. Pendleton, Bureau of Agriculture and Fisheries, Bangkok, Thailand.

Classification and Utilization of Land: Dr. J. W. Coulter, University of Hawaii, Honolulu, Hawaii.

Mountain Structure: Dr. H. A. Brouwer, University of Amsterdam, Amsterdam, The Netherlands.

Forestry: Dr. Arthur F. Fischer, Bureau of Forestry, Manila, Philippine Islands.

Economic Entomology: Dr. C. E. Pemberton, Hawaiian Sugar Planters' Association, Honolulu, Hawaii.

Blood Groups: Dr. Tanemoto Furuhata, Tokyo Imperial University, Tokyo, Japan.

Distribution of Terrestrial Faunas in the Inner Pacific: Dr. C. Montague Cooke, Bishop Museum, Honolulu, Hawaii.

Pacific Plant Areas: Dr. H. J. Lam, University of Leiden, Leiden, The Netherlands.

RECOMMENDATIONS OF THE CONGRESS

The council also gave extended attention to the need for coordination of efforts in successive congresses and drew up a number of recommendations, which were adopted by the congress, on ways and means of promoting scientific research in the Pacific region. These proposals, as outlined herewith, are to be brought to the attention of the proper authorities by the interim secretary, Dr. Patrocinio Valenzuela: (1) advocating the establishment of additional seismological stations in the Pacific area; (2) advocating extension of observations of gravity values within the Pacific; (3) advocating the construction and operation of non-magnetic vessels for a more complete magnetic survey of the Pacific region; (4) advocating the extension of coastal surveys to inadequately charted coasts of the Americas and of the Pacific Islands; (5) recommending continued study of the configuration of the floor of the Pacific Ocean by sonic sounding; (6) recommending continuation and extension of the oceanographic program of the International Fisheries Commission; (7) recommending further studies of the nature and origin of coralline deposits; (8) recommending that island stations and ships in the Pacific be required to provide full synoptic weather reports four times daily; (9) recommending preparation of large-scale exhibits of geological columns of each country of the Pacific; (10) advocating preservation of a number of unique natural areas within the Pacific region; (11) recommending appointment of a Standing Committee on Plant Areas; (12) recommending prosecution of an extensive project of soil classification and survey to be coordinated with the activities of the Fifth Commission of the International Society of Soil Science; and (13) recommending inclusion of discussions on public health and nutrition in the seventh Pacific Science Congress.

PUBLIC LECTURES

While the main emphasis of the congress was placed upon the technical sessions, arrangements were made for a number of illustrated lectures which were open to the public. Two of these lectures were given at the University of California in connection with the program on public health and nutrition, a series of seven was given at the Conference Room of the Pacific House on Treasure Island, and three were given at Stanford University. The names of speakers and the titles of their addresses follow:

At the University of California:

"The Present Status of Health Conditions in Canada." Dr. C. P. Brown, Canadian Department of Pensions and Public Health.

"The Progress of Health Work and Social Services in the British Colonies." Sir William McLean, representative of the British Colonies at the New York World's Fair.

At Treasure Island:

"Ocean Currents of the Pacific and Their Bearing on the Climates of the Coasts." Dr. H. U. Sverdrup, Scripps Institution of Oceanography.

"Public Health Conditions in China." Dr. A. Stampar, professor of public health, Zagreb.

"The Origins of Cultivated Plants in Relation to the Origins of Civilizations." Dr. Elmer Drew Merrill, Harvard University.

"Explorations in the Lesser Sunda Islands." Dr. H. A. Brouwer, University of Amsterdam.

"The Structure of the Pacific Ocean as Indicated by Earthquakes." Dr. Beno Gutenberg, California Institute of Technology.

"On Mimicry in its Relation to Other Forms of Protective Coloration." Dr. G. D. Hale Carpenter, Oxford University.

"The Government Botanic Gardens at Buitenzorg and the Mountain Garden at Tjibodas, Java." Dr. H. J. Lam, University of Leiden.

At Stanford University:

"Pithecanthropus and Sinanthropus and Their Relationship to Later Stages of Human Evolution." Dr. Franz Weidenreich, Peiping Union Medical College.

"The Biology of the Great Barrier Reef." Dr. C. M. Yonge, University of Bristol.

"The Flora of the Hawaiian Islands and the History of the Pacific Basin." Dr. Carl Skottsberg, Gothenburg Botanical Gardens.

Radio Broadcasts

A number of radio broadcasts were arranged through the courtesy of Dr. Milton Silverman, director of the Hall of Science at the Exposition. A series of three round-table broadcasts under the general title, "Meet the Scientists," was given on Monday evenings, over W6XBE (now KGEI), the General Electric short-wave station and over the Blue Network of the National Broadcasting Company, through KGO. In this series, on July 24, Dr. Karl F. Meyer, of the Hooper Foundation, and Sir William McLean, representative of the British Colonies at the New York World's Fair, discussed with Dr. Silverman international aspects of the public health problems of the Pacific area; on July 31, Dr. E. D. Merrill, of Harvard University, and Dr. Carl Skottsberg, of Gothenburg, discussed botanical problems of the Pacific, and on August 7, Mr. E. C. Andrews and Dr. H. C. Richards of Australia participated in a discussion of geological problems of the region.

Besides these programs, which were released over a national hook-up, fifteen-minute broadcasts were arranged over W6XBE after each of the seven public addresses at Treasure Island. At these broadcasts Dr. Silverman interviewed the speaker of the evening in the general field of his subject.

Social Events

The social program of the congress included a variety of events, some arranged by the congress through the services of Dr. Chauncey D. Leake and some by the officers of the Golden Gate International Exposition, particularly through the courtesy of the Women's Board of the Exposition and also through the active interest of Mr. and Mrs. Philip N. Youtz of the Pacific House. The congress is deeply grateful to the many persons who assisted in the preparation of these events, for they were all enjoyable, well-attended affairs which provided an unusual opportunity for members of the congress to meet and become acquainted with one another.

At Berkeley, the officers of the congress tendered a reception to members of the congress on Monday afternoon, July 24, at the university in the Women's Club Rooms of Stephens Union. On Wednesday afternoon, July 26, a short sight-seeing trip through the Berkeley Hills was followed by a reception and tea at the Women's Faculty Club of the university. On Saturday, July 29, an international tea and program was given at the Berkeley Women's City Club. On Wednesday afternoon, August 2, a sight-seeing trip through Marin County, including visits to the Muir Woods redwood grove and Mount Tamalpais, was followed by a reception and tea at the Pacific House on Treasure Island.

The formal banquet of the congress, in honor of visiting foreign delegates, was held at the Claremont Hotel on Friday evening, August 4. Dr. C. B. Lipman was toastmaster, and the speakers were Dr. Ross G. Harrison, president of the congress; Dr. Patrick Marshall (New Zealand), Dr. Y. R. Chao (China), Dr. Walfrido de Leon (Philippine Islands), Dr. Luis Patiño-Camargo (Colombia), and Dr. Carl Skottsberg (Sweden).

At Treasure Island, an elaborate special program of hospitality arranged by exposition officers began on Thursday afternoon, July 27, with a reception in the lounge of the San Francisco Building. Mayor Angelo J. Rossi and other officers of the city government extended greetings to members of the congress. On Friday afternoon, July 28, Mr. Koiti Tenniti, the Japanese Commissioner to the Exposition, tendered a reception to members of the congress at the beautiful Japanese Pavilion. A musical program was given and *tenpura* refreshments were served in the Japanese style. On Monday afternoon, July 31, Mr. George

Creel, United States Commissioner to the Exposition, tendered a reception to officers and delegates of the congress at the Federal Building, and on Tuesday afternoon, August 1, coffee was served to members of the congress at a number of pavilions in the Latin American Court, particularly in those of Brazil, Colombia, El Salvador and Guatemala. The Committee of the Pacific Area tendered a reception to members of the congress on Wednesday afternoon, August 2, at the Balcony of the Pacific House, following the sight-seeing trip to Marin County. Finally, on Thursday afternoon, August 3, the Women's Board of the Exposition received members of the congress at the Yerba Buena Club. Besides these events, arrangements were made by members of the Women's Board for individual entertainment of the speakers, together with invited guests, at Treasure Island at dinner preceding their evening addresses, and many smaller parties were entertained at week-end affairs. After each evening address, Mr. and Mrs. Youtz served refreshments in the Balcony at the Pacific House.

At Stanford University, a tour for ladies was given on Monday afternoon, August 7. Mrs. Herbert Hoover received the ladies at her home on the campus, and at the conclusion of the tour, tea was served at the home of Professor and Mrs. F. M. MacFarland. On Tuesday, August 8, many of the members of the congress participated in the excursion to Pacific Grove, which included a visit to the Hopkins Marine Station, a trip over the famed Seventeen-mile Drive on the Monterey Peninsula and a luncheon at the Peninsula Country Club arranged through the courtesy of Dr. W. K. Fisher, director of the Hopkins Marine Station. On Wednesday afternoon, August 9, a sight-seeing tour through the Peninsula District was followed by a reception and tea in the Patio of the Women's Gymnasium. On Thursday afternoon, August 10, Professor and Mrs. Bailey Willis entertained the members of the congress at their home on the campus.

THE TECHNICAL SESSIONS

Only the briefest attention can be given to the technical sessions, which constituted the most important feature of the congress. About 125 sessions were held, and over 700 papers were listed for presentation. In some instances excursions, motion picture films, laboratory demonstrations and luncheons and dinners were scheduled as part of these programs.

The program was organized into eight sections with eighteen major subdivisions. In general a committee appointed by the National Research Council on nomination of the Committee on the Congress was placed in charge of each major subdivision, and to it was delegated the details of organization of the program and the duty of extending invitations to participate in it. In view of the short time available for this purpose, invitations to participate were extended not only to the national organizations of the countries of the Pacific but also directly to individual scientists in these countries who were known to have made significant contributions in the fields under discussion.

The program committees were allowed a considerable degree of freedom in conducting their activities. Usually, however, a program outline was set up, enumerating general topics for consideration, and then invitations to participate were extended to individuals who had made notable contributions to the subjects in question.

Geophysics: Beno Gutenberg, Perry Byerly, A. L. Day and N. H. Heck, in charge. On July 27, the subsection was invited to participate in a program on earthquake resistant design, arranged by the Structural Division of the American Society of Civil Engineers and held at the St. Francis Hotel in San Francisco. Sessions were held on magnetic data and the structure of the Pacific area; on shallow earthquakes in the Pacific area and structure; on deep focus earthquakes in the Pacific area; on gravity, tilt and displacement in the Pacific area; and on hypotheses on the development of the Pacific basin. One session was devoted to a general conference on geophysical problems concerning the Pacific area, and the subsection participated in sessions dealing with Pacific climates, as based on the fossil record, and with causes of climatic change. The standing committee on seismology also held a meeting under the *pro tempore* chairmanship of James B. Macelwane, of St. Louis University.

Geology: Eliot Blackwelder, Herbert E. Gregory and W. C. Mendenhall, in charge. The committee in charge of the subsection on geology outlined a number of topics and delegated the preparation of programs for these subjects to specialists in the fields. A program of six sessions on the Pacific basin and lands in pre-Tertiary times was arranged by C. E. Weaver, of the University of Washington. H. G. Schenck, of Stanford University, arranged a program of four sessions on Tertiary stratigraphy, paleontology and history of the islands in and the continents bordering on the Pacific Ocean. A fifth session was devoted to a round-table conference on procedure in stratigraphy; and two field trips were conducted; one to the south side of Mount Diablo, under the leadership of B. L. Clark, of the University of California, and another to inspect the southwest flank of the Pacheco syncline near Martinez, under the leadership of the chairman.

A one-session program on Antarctic Pacific, continental and marine problems was arranged by L. M. Gould, Carleton College; and a two-session program on the bottom deposits of the Pacific Ocean and processes of marine sedimentation by Parker D. Trask, of the U. S. Geological Survey. One-session programs

were devoted to Pleistocene and Recent changes around the Pacific border, under the leadership of Eliot Blackwelder, of Stanford University, to changes of ocean level in the Pacific basin under J. E. Hoffmeister, of the University of Rochester, and to volcanoes of the Pacific region under the direction of Howel Williams, of the University of California.

Oceanography and Marine Biology: The section was organized under the general supervision of a committee consisting of Thomas G. Thompson, Martin W. Johnson, H. A. Marmer, Robert C. Miller, H. U. Sverdrup and W. F. Thompson. It was divided into three subsections—oceanography, fisheries and marine biology—for development of the program. General activities of the section included consideration of an extensive report drawn up by the Standing Committee on Oceanography of the Pacific, of which Thomas G. Thompson was chairman. The Oceanographical Society of the Pacific held its annual luncheon and business meeting in connection with these sessions on July 27, at the Berkeley Women's City Club.

Oceanography: H. U. Sverdrup, in charge. The first session was devoted to oceanographic reports from various portions of the Pacific region. It was followed by two sessions devoted to currents of the Pacific Ocean, their physical and chemical characteristics, and concluded with a session devoted to contributed papers.

Fisheries: W. F. Thompson, Harry A. Dunlop, Roger W. Harrison, George S. Myers, Paul R. Needham and W. L. Scofield, in charge. Seven sessions were held. The first dealt with the distribution and relationship of marine species, stressing those features which make them of international importance. The second was devoted to the life history of important species of fishes and the factors in their exploitation and conservation which make them of international importance. The third session dealt with the evolution of methods of exploitation and utilization, the scientific and practical principles involved and their relation to conservation or the national economy of the countries of the Pacific area. The fourth session considered management methods for inland waters, and the fifth discussed fisheries research programs. Two following sessions contained miscellaneous contributions on fisheries biology and technology.

Marine Biology: Robert C. Miller, Martin W. Johnson, Frederick H. Davidson, C. McLean Frazer, Trevor Kincaid, S. F. Light and Irene A. McCulloch, in charge. Two sessions were devoted to the distribution of plant and animal life in the Pacific and one each to the productivity of the sea, the microbiology of the sea, the tropical Pacific and the physiology of marine organisms. Round-table discussions in connection with the sessions were scheduled to deal with the present status of distributional studies in the north Pacific area, the utilization of "indicator" organisms in marine biological investigations, the objectives of future biological investigations in the tropical Pacific and the present status of investigations of the morphology and physiology of Pacific invertebrates.

Past Climates of the Pacific: Ralph W. Chaney, in charge. Two sessions were devoted to a consideration of Pacific climates as based on the fossil record in which evidence from the response of modern organisms to climate as well as evidence from the fossil record were considered. A third session was devoted to a discussion of causes of climatic change.

Present Climates of the Pacific: Charles F. Brooks, E. H. Bowie and J. B. Leighly, in charge. Two subsections, one dealing with meteorology and the other with climatology, were organized.

Meteorology: E. H. Bowie, N. E. Bradbury and E. C. Haynes, in charge. Five sessions were scheduled for a consideration of the synoptic meteorology of the Pacific. During these sessions a movie film on the artificial production of snow crystals, prepared by Professor Ukitiro Nakaya, of the Hokkaido Imperial University, and brought to the congress by Dr. K. Hidaka, was shown. Another feature of the program was a daily air-mass-frontal analysis of the weather chart of the north Pacific Ocean, presented by Messrs. H. B. Byers, R. C. Counts, Jr., and E. M. Vernon, of the U. S. Weather Bureau.

Climatology: John B. Leighly, in charge. Three one-session programs were arranged dealing with the maritime climatology of the Pacific, climatic fluctuations in California and climatic features of the western United States.

Anthropology: A. L. Kroeber and T. D. McCown, in charge. The program was divided into six sessions with the following topics of discussion: culture history; acculturation; regional contributions; ethnobotany; earliest man, his remains, his tools and the times in which he lived; and racial migrations in the Pacific region.

Zoology: F. M. MacFarland, H. Burrington Baker, Ernst Mayr and Karl P. Schmidt, in charge. Two sessions of the subsection, dealing with the general subject of faunistic studies of the Pacific area, were organized.

Entomology: E. O. Essig, C. P. Clausen, W. B. Herms, D. B. Mackie and E. C. Van Dyke, in charge. The several portions of the program were organized by different members of the committee. A two-session program on the faunal relations of the insects of the Pacific area was arranged by E. C. Van Dyke. A session dealing with economic problems was held under the leadership of D. B. Mackie. Four sessions under the leadership of C. P. Clausen were devoted to the general problem of biological control of insect pests; and one session on the terrestrial arachnids of

the Pacific area which may affect the health and well-being of man and animals was organized by W. B. Herms.

Botany: E. B. Copeland, in charge. The general topic of discussion was the terrestrial floras of the Pacific area, to which three sessions were devoted. A fourth session was devoted to contributed papers on economic applications dealing particularly with plant breeding and forestry. The subsection also participated in a discussion of reports of the Standing Committee on Forestry, presented by F. W. Foxworthy and of the Standing Committee on the Protection of Nature, prepared by Carl Skottsberg.

Plant Pathology: E. C. Stakman, in charge. The program consisted of four sessions; one devoted to virus diseases of plants with a round-table discussion of virus problems led by Eubanks Carsner; a second dealt with variation in plant pathogens, with a round-table discussion on variation in pathogens and its importance, led by M. W. Gardner; a third considered the problem of dissemination and distribution of plant pathogens including physiologic races, led by J. H. Craigie; and the fourth, devoted to plant diseases caused by nutrient deficiencies, included a round-table discussion on diseases caused by nutrient deficiencies and mutual relationships between organisms in relation to pathogenicity.

Public Health and Nutrition: K. F. Meyer, L. S. McClung, F. A. Carmelia, L. R. Chandler, W. M. Dickie, C. E. Dolman, J. C. Geiger, Ira V. Hiscock, C. H. Kellaway, J. F. Kessel, C. D. Leake, G. W. McCoy, Agnes F. Morgan, R. R. Parker, Langley Porter, A. C. Reed, R. R. Sayers, W. P. Shepard and R. P. Strong, in charge. The inclusion of the section on public health and nutrition represented, in a sense, an innovation in the program of Pacific Science congresses, since the fifth congress, after considering the matter, abandoned plans to organize such a section, and previous congresses had laid little emphasis on the field. However, through the active services of Dr. K. F. Meyer and Dr. L. S. McClung, chairman and secretary, respectively, of the organizing committee, together with the associated efforts of a large group interested in the subject, an extensive program was prepared and presented. The section was so successful in its efforts that the congress endorsed its request for continuation of the section in subsequent congresses.

General activities of the group included arrangements for the three public lectures previously listed, given by Dr. C. P. Brown, Sir William McLean and Dr. A. Stampar. A dinner in honor of officers of the section and visiting participants was given at the Faculty Club of the University of California on Thursday evening, July 27. Moving picture films in color were shown on Tuesday evening, July 25, "A Trip to Panama; Possibilities for Nutrition Research in the Tropics," by Dr. George R. Cowgill, of Yale University, and on Saturday afternoon, July 29, films were exhibited by Dr. R. R. Parker on the "Life History of the Rocky Mountain Spotted Fever Tick, and Methods of Preparation of Rocky Mountain Fever Vaccine."

The technical sessions were organized under four subsections; epidemiology, industrial hygiene, nutrition and health education. As previously mentioned, the program was so arranged as to permit attendance of members of the Western Branch of the American Public Health Association, which met in Oakland from July 23 to 28. Members of the congress were also invited to attend the annual banquet of the association, which was held on Wednesday evening, July 26, at the Hotel Oakland.

Epidemiology: K. F. Meyer, in charge. The program consisted of sixteen sessions organized around specific topics, with 172 papers listed for presentation. An attempt was made to secure reports on these topics from as wide a territory as possible. One session dealt with the enteric infections; dysenteries, cholera and typhoid fever. It was followed by two sessions on insect-borne diseases; one covering tularemia and relapsing fever; the other, yellow fever and plague. Two sessions dealt with neurotropic virus infections; one with poliomyelitis, equine encephalomyelitis, St. Louis encephalitis and rabies; the second with undulant fever and leptospirosis. Two sessions on animal-borne diseases covered undulant fever, leptospirosis and psittacosis. One session was devoted to food poisonings and one to the history and influence of geographic and climatic factors on disease. Three further sessions on insect-borne diseases dealt with rickettsia and bartonella infections. A session was given over to fungus infections, another to newer knowledge on trachoma and two to leprosy.

Industrial Hygiene: Dr. R. R. Sayers, in charge. The program consisted of four sessions, with 34 papers listed for presentation. One session was devoted to a consideration of the present status of industrial hygiene; a second to public health problems relating to transportation and changes in barometric pressure; and two to organic solvents, insecticides, pest control agents and spray residues in relation to public health.

Nutrition: Agnes F. Morgan, C. L. Alsberg, L. S. McClung and K. F. Meyer, in charge. Eight sessions were held at which 64 papers were listed for presentation. The group also gave a luncheon at the Women's Faculty Club, University of California, on Tuesday, July 25. Two sessions dealt with the probable nutritional inadequacies of diets in common use by Pacific populations; the first with the white bread, sugar and meat diet of the Occident, and the second with the polished rice and fish diet of the Orient. These were followed by a session on vitamin requirements and vitamin content of foods of the Pacific area. One

session was given over to the value of the soybean in supplementing deficient diets; one to the avitaminoses and alcoholism and metabolism; and one to fortification of foods with vitamins and hypervitaminoses. A further session dealt with nutrition as a factor in the geographical distribution of dental caries and paradentosis; and a final session was given over to a discussion of defective nutrition and public health.

Health Education: Dr. Ira V. Hiscock and Dr. W. P. Shepard, in charge. The sessions on health education were all joint sessions arranged by the Western Branch of the American Public Health Association. The sessions were opened by a symposium on health education at which addresses and reports upon various aspects of health education were presented. Following this session the program was divided into five sessions meeting simultaneously; three dealing with school health education (health instruction in the classroom, health service in schools and physical education and recreation), and two with health education of the public. The sessions continued with a résumé of the discussions on school health education and with further sessions on health education of the public. The sessions concluded with a general symposium on health education at which Dr. Walter H. Brown summarized the discussion on school health education, Dr. W. Ford Higby that on health education of the public, and Dr. Ira V. Hiscock discussed health education in the U. S. A.

Soil Resources: C. F. Shaw, S. W. Cosby, M. H. Lapham, R. E. Storie and W. W. Weir, in charge. This section, under the leadership of the late C. F. Shaw, was somewhat differently organized from the other sections. The main emphasis was laid on informal discussion of topics rather than upon formal presentation of papers. Included in the program were two two-day field trips; one to Placerville and way stations and one to Watsonville and Santa Cruz and way stations to inspect projects dealing with land use and methods of conservation and to serve as a basis for discussions at following sessions. Sessions were devoted to natural factors determining land use; soil, climate, water supply and topography, and to methods of study and mapping of the natural factors determining land use. A series of sessions were devoted to soil conditions and land use in various localities; in the foothills and interior valleys of California, in Oregon, in Washington, in the western Canadian provinces, in Central America, in Mexico, in China, in the tropical Pacific, in Australia and New Zealand, and in the Pacific coastal regions. The sessions closed with a general discussion of soil problems of Pacific lands.

THE STRUCTURE OF THE PACIFIC BASIN AS INDICATED BY EARTHQUAKES[1]

By Professor B. GUTENBERG

CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA

OUR earth originated about 2,000 million years ago. Great changes must have occurred in its early history, but even yet both gradual and sudden changes show us that it has not gained complete equilibrium. The sudden movements, which we call earthquakes, give us important information about the constitution of the earth.

The main features of earthquakes are fractures and displacements which occur usually at some depth, the focus of the earthquake, but which occasionally may extend to the surface and be visible there in the form of cracks, displaced roads or fences, etc. Such displacements frequently recur for long intervals in time and space in the same direction. A well-known example is the fault system in California, especially the San Andreas fault. The movements there occur in such a way that the eastern (continental) side moves southeastward relative to the western (Pacific) side. The same fact is proved by geologic measurements in Japan.[2] As mentioned already, movements occur gradually as well as during earthquakes. If in a certain region a block along one side of the fault moves gradually in one direction relative to the block on the other side, strains will be set up along the fault which finally lead to an earthquake at the time when the strain exceeds the breaking strength of the material and a break occurs. At this moment the material on one side of the fault "snaps" towards the unstrained position in one direction, that on the other side of the fault in the opposite direction. On both sides there is a compression in the direction in which the "snapping"

[1] Abstract of a public address at the Sixth Pacific Congress, Berkeley, Calif., August 1, 1939.

[2] During the meeting of the Pacific Science Congress Professor Ch. Tsuboi stated that in Japan, along all faults without exception, the continental (western) side is moving southward relative to the Pacific side; and, according to a statement by Dr. Bailey Willis, movements along the major fault in the Philippines occur in the same way, the continental side moves southward relative to the Pacific side. These results suggest the possibility of a general movement of Eastern Asia and Western North America to the south relative to the Pacific Basin. However, many more observations are needed before this can be considered a fact.

occurs and a dilatation in the opposite direction so that in such a simple case we should expect two quadrants about the source in which compressional waves are observed and two with dilatational waves. It is of interest that such patterns of compressions and dilatations are actually observed in earthquakes. More complicated patterns occur when the shock occurs at some depth and along a fault plane which is not vertical. The fact that thus far definite patterns have been observed in all earthquakes (no data exist for those produced by volcanic eruptions) regardless of their focal depth indicates that in all shocks the processes producing the waves are of the same type of "faulting" (shearing) and can not be due to a pure explosion or collapse in the interior of the earth.

The "shallow" earthquakes (less than 30 miles deep) show one belt of high activity around the Pacific Ocean, and another through southern Asia and the Mediterranean. The "great" earthquakes are more common around the Pacific. A still larger percentage of the "intermediate" shocks (depth 30 to 200 miles) and all very deep shocks which have been found thus far (maximum depth about 450 miles) originate in the circum-Pacific area. The boundary of the true Pacific Basin is outlined by the earthquake epicenters. On the west side it follows the "Andesite line," which separates regions of different petrologic and chemical composition, and runs east of Japan, the Marianne Islands, the Palau Islands, thence north of New Guinea and the New Hebrides towards the islands of Samoa which are on the Pacific side, and then turns southward, leaving the Kermadec Islands and New Zealand on the "continental" side. On the American side, the boundary is close to the coast. The fact that the foci of all earthquakes originating deeper than 200 miles have been found close to and on the continental side of this boundary indicates that the Pacific Basin has a unique structure.

The waves produced by an earthquake spread in all directions. There are different types, which are characterized by different modes of vibrations and different speeds. The fastest waves are of the "push-pull" (longitudinal) type and travel through the interior of the earth. They are followed by vibrations in which the particles vibrate sidewise back and forth. The last group are various types of surface waves, traveling exclusively along the surface of the earth. The speed of the first waves has been determined in various regions. The results indicate that certain granitic and basaltic layers exist in the continental regions down to a discontinuity at depths between 20 and 35 miles, depending on the locality. The data for the Pacific Basin are scant and agree with the assumption that the continental surface layers are missing there. On the other hand, in Japan and New Zealand, which we have considered already as belonging to the "continental" area, these continental surface layers clearly exist, though their thickness is relatively small; this is true also for the California coastal region.

The waves traveling along the surface lead to similar conclusions. They show, in addition, that the surface structures of the Atlantic and Indian Oceans are similar to those under the continents, but much thinner. Surface waves crossing the boundaries of the Pacific Basin lose a noticeable fraction of their energy, which indicates this boundary is a marked discontinuity between different structures. The fact that very long waves are not appreciably affected leads to the conclusion that the difference between these structures ends at a depth of noticeably less than 100 miles.

Finally, waves which are reflected at the surface of the earth can be used to deduce conclusions as to the conditions at the point of reflection. If the distance between the source of the shock and the recording stations exceeds a few thousand kilometers, the energy of the "echo" is stronger if the reflection has taken place within the continental surface layer than if this was absent at the point of reflection. Discussion of these observations has confirmed results from other sources and added some details as to the exact location of the boundary of the "Pacific Basin." It has added evidence in favor of a limited area with continental structure in the southeastern part of the Pacific and of Pacific type of structure in a part of the Arctic basin.

All evidence available agrees with the conclusion that the layers which form the uppermost crust in the continents are lacking in the Pacific Basin as defined above. The belt surrounding the Pacific Basin is characterized by faults in great number. Earthquakes originating at depths from close to the surface down to several hundred miles and the existence of relatively large gravity anomalies in many of the areas involved leave no doubt that this belt is the most active region of the world and that changes are going on in it extending from the surface to a depth of a few hundred miles at least. These processes, on which local changes are superimposed, seem to persist in their directional characteristics over long-time intervals and over large distances, at least notable fractions of the Pacific boundary. The source of the energy which produces these movements and the mechanism involved are not known exactly. It seems very likely that subcrustal currents, perhaps due to thermal processes, and the difference in structure between the Pacific basin and the surrounding regions play an important role.

However, another conclusion is unavoidable: There is no reason why the earthquakes around the Pacific belt should cease. While we can not predict the exact time or location of coming shocks, there is no doubt that there will be great earthquakes somewhere around the Pacific Basin during each coming year. As a

matter of fact there is no day without small shocks in this narrow belt. However, there need not be any excessive damage connected with these shocks, even the greatest, as the science of engineering has made such progress during recent years that earthquake resistant structures can be built at a cost not exceeding much the cost of ordinary buildings. Just as large parts of California have been made "drought-proof," so that even in the driest years no lack of water is to be feared, all works of construction in the circum-Pacific belt should be made "earthquake proof," thus providing another triumph of science.

SCIENTIFIC EVENTS

THE CITY AND RURAL HEALTH CONSERVATION CONTEST

THE Chamber of Commerce of the United States in cooperation with the American Public Health Association has announced awards for the 1938 City Health Conservation Contest and the 1938 Rural Health Conservation Contest. These contests are said to be the most effective means of stimulating adequate health protection and health promotion services yet devised in this country.

Awards are made not necessarily to the healthiest communities, but rather on the effectiveness with which a community is meeting its health problems. Each city or county is appraised by a grading committee consisting of a group of carefully selected health experts from all parts of the country. Each community is appraised on what measures it takes: (1) to provide and safeguard its water supply; (2) to furnish adequate and safe sewerage disposal; (3) to reduce infant and maternal deaths; (4) to combat tuberculosis and syphilis; (5) to protect its citizens against other communicable diseases; (6) to insure healthy children; (7) to protect and safeguard its milk and other foods; (8) to promote effective cooperation with its physicians and dentists in furnishing necessary services to all those who need them; and (9) to enlarge and improve its lay-understanding of ways and means of preventing sickness and death and of maintaining good health.

The City Health Contest is financed by a group of life insurance companies. The Rural Health Contest is financed by the W. K. Kellogg Foundation of Battle Creek, Michigan. The contest in Canada is sponsored jointly by the Canadian Public Health Association and the American Public Health Association.

Two special contests, one on tuberculosis and one on syphilis, are carried on in conjunction with the City Health Contest. Awards are made to those competing cities which appear to have the most comprehensive and effective programs for combatting tuberculosis and syphilis as follows:

In Group I (cities over 500,000 population) Cleveland, Ohio, wins the first award. Awards of merit in this population group go to Buffalo, N. Y., and Pittsburgh, Pa.

In Group II (cities of 250,000 to 500,000 population) Providence, R. I., is the winner. Awards of merit in this group go to Memphis, Tenn.; Louisville, Ky.; Dallas, Texas, and Cincinnati, Ohio.

In Group III (cities of 100,000 to 250,000 population) the winner is Grand Rapids, Mich. Awards of merit go to Reading, Pa.; Yonkers, N. Y., and Erie, Pa.

In Group IV (cities of 50,000 to 100,000 population) the winner is Newton, Mass. Awards of merit go to Madison, Wis., Greensboro, N. C., and Evansville, Ill., tied.

In Group V (cities of from 20,000 to 50,000 population) the winner is Plainfield, N. J. Awards of merit go to Winona, Minn.; Orange, N. J., and Stamford, Conn.

In Group VI (cities of less than 20,000 population) the winner is Englewood, N. J. Awards of merit go to Hibbing, Minn., and Virginia, Minn.

In the 1938 Special Contest for Tuberculosis Control Hartford, Conn., and Newton, Mass., tied for first place. In addition a certificate of merit was awarded to New Haven, Conn. In the 1938 Special Contest for Syphilis Control the winner was Louisville, Ky.

THE EXPEDITION TO HUDSON BAY OF THE UNIVERSITY OF MINNESOTA

THE University of Minnesota Expedition to Hudson Bay returned to Minneapolis on September 18. It left Senneterre, P. Q., by plane on June 25, arriving at its objective, Richmond Gulf, on June 26.

Richmond Gulf is a large, triangular body of salt water in Lat. 56° 15′ N. and Long. 76° 30′ W. It is surrounded by hills rising 800 to 1,500 feet above sea level, making this region relatively rugged for the east coast of Hudson Bay. The thoroughly glaciated hills are composed of sedimentaries of various kinds overlaid or penetrated by diabase trap, and also are composed in some cases of Archaean granites.

Botanically, the area is significant not only because it has needed thorough botanical exploration, but also because it has a great diversity of habitats and lies at the transition from coniferous forest to the barren grounds.

The members of the expedition collected flowering plants, ferns and some mosses, lichens and hepatics in the Richmond Gulf area until August 13. At this time the party left by canoe for Great Whale River. Collections were made in the vicinity of Great Whale River and along Manitounuck Sound until the arrival of the Hudson's Bay Company's vessel on August 22. The opportunity was taken to accompany the vessel on its annual visit to the Belcher Islands, where further collections were made. The return trip on the vessel was completed on September 11 upon arrival at the

end of the railroad at Moosonee (Moose Factory), Ontario.

During the summer there were collected 1,336 numbers of flowering plants and about 400 numbers of lower plants, the number of herbarium specimens being about 8,000. In addition, about 250 tree borings and wood specimens from 80 trees were collected by John Marr for a study of tree growth climatic correlations.

The party was composed of Dr. Ernst C. Abbe, Mrs. Lucy B. Abbe and Mr. John Marr, a graduate student at the University of Minnesota.

The expedition was supported by funds from the Graduate School of the University of Minnesota, supplemented with liberal grants from the National Academy of Sciences (Bache Fund), the American Academy of Arts and Sciences, the Penrose Fund of the American Philosophical Society, the Smithsonian Institution, the Arnold Arboretum of Harvard University and the Minnesota Academy of Sciences.

ERNST C. ABBE

THE IMPORTATION OF FOREIGN BOOKS AND PERIODICALS

THE Executive Board of the American Library Association on October 3 arranged for the appointment of a Joint Committee on Foreign Importations to act on behalf of the association and also of the Medical Library Association, the Special Libraries Association, the Association of Research Libraries and the Association of College and Reference Libraries. One or two other organizations may join in the project later. The following, of whom the first four form the executive committee, have accepted appointment to membership in the committee:

Harry Miller Lydenberg, New York Public Library, *chairman.*
Robert Lingel, New York Public Library, *vice-chairman.*
Keyes D. Metcalf, Harvard University Library.
Thomas Paul Fleming, Medical Library, Columbia University.
Dr. William Warner Bishop, General Library, University of Michigan.
Lawrence Heyl, Princeton University Library.
Bernhard Knollenberg, Yale University Library.
Harold L. Leupp, University of California Library.
Dr. Phineas Lawrence Windsor, University of Illinois Library.

Messrs. Lydenberg and Lingel conferred in Washington on November 4 with Dr. Archibald MacLeish, librarian of Congress, and B. L. Hunt, assistant legal adviser of the Department of State. Dr. MacLeish assured them of the willingness of the Library of Congress to aid American Libraries if it became necessary to lay their case before diplomatic authorities. Mr. Hunt is acquainted with the library situation. He agreed to consider on behalf of the Department of State any statements forwarded by the Library of Congress and to see that action was taken through appropriate channels as the circumstances might warrant.

Present conditions facing American libraries may be summarized as follows: publications of all kinds will be irregular because of war conditions; shipments are subject not only to wind and weather but to transportation irregularities both on sea and land. So far as the committee can learn, however, no embargo on shipments of books and periodicals has been laid. Restrictions on exports of books from Italy were limited to a short period after the war began. On September 28, the Department of State cabled to the American Embassy in London, with a view to making some general arrangement for the transmission of general publications from Germany. As soon as a reply has been received by the Department of State, the committee will be advised. There seems, however, at the present time, to be no difficulty in exporting books and periodicals from Germany in neutral vessels. The report states that agents seem so far to have been able to make their shipments with no more delays or difficulties than one must expect under such circumstances. Further announcements will be made by the committee which has its headquarters at 476 Fifth Avenue, New York City.

The American Documentation Institute of the library of the U. S. Department of Agriculture, Washington, requests that failure by a subscriber to receive European scientific journals be reported promptly. The cultural relations committee of the institute hopes to be able to surmount such war obstacles as interrupted transportation, embargoes and censorship, which seriously affected the progress of research during the last war. It is hoped that the principle will be established that materials of research having no relation to war shall continue to pass freely, regardless of the countries of origin or destination. Reports with full details of where subscription was placed and name and address of subscriber, volume, date and number of the last issue received should be addressed to the American Documentation Institute, Bibliofilm Service, U. S. Department of Agriculture Library, Washington, D. C.

LECTURES IN THE DEPARTMENT OF PHYSICS AT THE UNIVERSITY OF WISCONSIN

DURING the academic year 1938–39 and the summer of 1939 the following speakers from out of town gave talks before faculty members and graduate students of the department of physics at the University of Wisconsin:

November 23, Dr. L. N. Ridenour, University of Pennsylvania, Artificial Radioactivities.

J. Schwinger, Columbia University, The $[\sigma_1\sigma_2 - 3(\sigma_1 r)(\sigma_2 r)r^{-2}]J(r)$ terms and the quadrupole moment of H^2.

December 2, Professor Otto Struve, Yerkes Observatory, Interstellar Absorption and Emission.

December 14, Professor S. Chandrasekhar, Yerkes Observatory, Stellar Structure and Stellar Energy.

December 16, Dr. K. K. Darrow, Bell Telephone Laboratories, History of the Mesotron.

January 6, Dr. D. P. Johnson, U. S. Bureau of Standards, Mercurial Thermometers.

April 4, Professor I. I. Rabi, Columbia University, Experiments with Molecular Beams on Nuclear Magnetic Moments.

Dr. M. Goldhaber, University of Illinois, Slow Neutron Boron Reaction.

April 14, Professor L. Brillouin, Collège de France, Spins and Statistics of Elementary Particles.

May 12, Professor R. S. Mulliken, University of Chicago, Intensities of Electronic Transitions and the Color of Organic Compounds.

May 19, Professor A. Ellett, State University of Iowa, The $D + D \rightarrow H_1 + H_3$ Reactions. Dependence of Angular Distribution and Cross Section upon Energy.

May 25, Professor A. H. Compton, University of Chicago, The Production and Disintegration of Mesotrons.

June 7, Dr. E. Feenberg, New York University, Canonical Transformations for Field Theories.

July 3, Dr. S. A. Korff, Bartol Foundation, Neutrons in Cosmic Radiation.

July 12, Professor Otto Struve and Dr. L. G. Henyey, Yerkes Observatory, Spectroscopic Evidence Regarding Interstellar Matter.

July 19, Professor T. W. Bonner, Rice Institute, Recent Work in Nuclear Physics at the Cavendish Laboratory.

AWARD OF THE JOHN FRITZ GOLD MEDAL

THE posthumous award of the 1940 John Fritz Gold Medal to Dr. Clarence Floyd Hirshfeld, who until his death on April 19 of this year was chief of research of the Detroit Edison Company, has been announced.

The medal, given annually for notable scientific or industrial achievement by a board composed of sixteen representatives of the four national societies of civil, mining and metallurgical, mechanical and electrical engineers, was given to Dr. Hirshfeld "for notable leadership through research and development in power generation and electric traction, and for being a great teacher and friend of men both young and old."

Modernization of the electric street-car completely from trolley wire to track is among the many advances in engineering credited to Dr. Hirshfeld. His career extended over thirty-six years and included teaching, writing and direction of research work. He was born in San Francisco on January 30, 1881. From 1903 to 1914 he taught at Sibley College of Cornell University, becoming professor of mechanical engineering. In 1913 he organized for the Detroit Edison Company what is thought to be the first research department established and maintained by an electrical city supply company, where he became chief of research.

Dr. Hirshfeld was chief engineer of the Electric Railway Presidents' Conference Committee. He was the author of many books and articles on technical subjects, dealing principally with thermodynamics, steam power and problems of the transit industry. He was a member of the American Committee of the World Power Conference and of the U. S. National Committee of the International Electrotechnical Commission. He also served on the board of national councilors of the Purdue Research Foundation and on the advisory council of Yenching University. He was the first chairman of the Engineers' Council for Professional Development, and belonged to many scientific societies.

Dr. Hirshfeld was being considered as a candidate for the Fritz Medal at the time of his death. The award was, therefore, made posthumously.

RECENT DEATHS AND MEMORIALS

DR. LIVINGSTON FARRAND, president emeritus of Cornell University, who was from 1903 to 1914 professor of anthropology at Columbia University, died on November 8 at the age of seventy-two years.

DR. WILLIAM H. BROWN, lecturer in botany at the Johns Hopkins University, previously from 1924 to 1933 director of the Bureau of Science at Manila, P. I., in charge of scientific investigations for the Philippines, died on November 9. He was fifty-five years old.

DR. FREDERICK ADAMS WOODS, formerly lecturer in biology at the Massachusetts Institute of Technology, who since 1927 has lived in Rome, died on November 5 at the age of sixty-six years.

DR. ALFRED ALEXANDER DIXON, professor of physics at the North Carolina State College of Agriculture and Engineering, died on October 15 at the age of fifty-three years.

WILLIAM ARTHUR COWAN, who served for forty years as chemist of the National Lead Company, died on October 27 at the age of sixty-five years.

DR. L. O. ELLISOR, assistant entomologist at the Louisiana Agricultural Experiment Station, died on October 21 at the age of twenty-nine years. Bullion A. Osterberger, also assistant entomologist at the station, died on May 20.

DR. RALPH ALLEN SAMPSON, Astronomer-Royal for Scotland from 1910 to 1937, professor of astronomy at the University of Edinburgh, died on November 10 at the age of seventy-three years.

TRIBUTE to the late Dr. W. E. Britton, Connecticut state entomologist from 1901 until the time of his death last February, was part of the program of the sixteenth annual conference of Connecticut entomologists that met on October 27 at the University of Connecticut at Storrs. The principal address was given by Dr. E. Porter Felt, formerly state entomologist of New York and now director of research at the Bartlett Tree Laboratories at Stamford.

THE *Journal* of the American Medical Association states that, in response to the request of many members, the council of the Minnesota State Medical Association sponsored a memorial pilgrimage to Rochester on October 27 to pay tribute to Drs. William J. and Charles H. Mayo. Every member of the association was invited to participate in the ceremonies at Plummer Hall in the Mayo Clinic and at Oakwood Cemetery. With Dr. George A. Earl, St. Paul, president of the state medical association, presiding, Dr. Edward L. Tuohy, Duluth, gave the address entitled, "An Expression from the Medical Profession of Minnesota." There followed a procession to the cemetery.

SCIENTIFIC NOTES AND NEWS

THE Nobel Prize in physics for 1939 has been awarded by the Swedish Academy of Science to Dr. Ernest O. Lawrence, professor of physics and director of the radiation laboratory of the University of California, in recognition of his research into the structure of atoms and the use of radiation in problems affecting biology and medicine.

THE Nobel Prize in chemistry for 1939 has been divided between Professor Adolf Butenandt, director of the Kaiser Wilhelm Institute for Biochemistry at Berlin-Dahlem, and Professor Leopold Ružička, of the Technische Hochschule, Zurich, in recognition of their work on hormones. The prize in chemistry, which was withheld last year, has been awarded to Professor Richard Kuhn, of the Kaiser Wilhelm Institute of Berlin, for his work on carotinoids and vitamins. It is expected that if Professor Butenandt and Professor Kuhn are unable to accept the prizes the money will be returned to the Nobel Foundation.

THE University of Paris on November 9 conferred honorary degrees on Dr. Robert Andrews Millikan, chairman of the executive committee of the California Institute of Technology; on Sir Humphry Rolleston, who was from 1925 to 1932 regius professor of physic at the University of Cambridge, and on Dr. Philippe Roy, Montreal physician, since 1928 Minister to France from Canada. President Lebrun and the Minister of Education, M. Yvon Delbos, attended the ceremony.

THE Gordon Wilson Medal of the American Clinical and Climatological Association was presented at the meeting on October 10 at Saranac Lake, N. Y., to Dr. George R. Minot, professor of medicine at the Harvard Medical School. On that occasion he gave the Gordon Wilson Lecture before the association.

DR. LOUIS DAVIDSON RICKETTS, of Arizona, consulting engineer, has been chosen the James Douglas gold medalist for 1940 by the American Institute of Mining and Metallurgical Engineers, in recognition of his "inspirational leadership and distinguished achievements in the metallurgy of copper." Dr. Ricketts, who is now eighty years old, was at one time state geologist of Wyoming and was later associated with Phelps, Dodge and Company.

AT the meeting of the American Public Health Association in Pittsburgh, on October 18, the 1939 awards of the Pennsylvania Public Health Association were presented to Professor C. G. King, of the department of chemistry, University of Pittsburgh, in recognition of his research work in biochemistry and nutrition, and to Professor H. T. Price, of the School of Medicine, for his clinical and educational work in the field of pediatrics.

THE Royal Australian Ornithologists Union has elected Dr. Robert Cushman Murphy, of the American Museum of Natural History, a corresponding member in recognition of his active interest in the conservation of wild life.

DR. PERCY BARTLETT, for thirty-five years a member of the faculty of the Medical School of Dartmouth College, has retired with the title of professor emeritus of surgery.

DR. CARLO J. TRIPOLI has been appointed professor of medicine in charge of the department of medicine of the Graduate School of Louisiana State University.

DR. RAYMOND L. GREGORY, professor of medicine at Howard University College of Medicine, Washington, has been appointed professor and head of the department of medicine at the University of Arkansas School of Medicine.

DR. ROBERT M. DICKEY, since 1936 head of the department of geology and mineralogy of the Michigan College of Mining and Technology, has resigned to become an engineer with the Bucyrus-Erie Company. His headquarters are in Chicago. Dr. Thomas M. Broderick will serve as acting head of the department until a permanent successor can be named, probably

about January 1. Dr. Broderick is chief geologist of the Calumet and Hecla Consolidated Copper Company, and has been also for some years a special lecturer at the college.

DR. JOHN G. B. CASTOR, assistant in plant physiology at Harvard University, has become a member of the Division of Viticulture at Davis of the University of California. He will work on the microbiology of wine.

DR. WILLIAM G. GORDON, for the past four years instructor in biochemistry at Stanford University, has been appointed Smith, Kline and French Laboratories research fellow in the department of agricultural biochemistry at the Pennsylvania State College. He will work in the field of milk protein.

DR. WALTER M. SCOTT, for the last nine years consulting chemist for G. J. Esselen, Boston, has been appointed chief of the Cotton Chemical Finishing Division of the Southern Regional Research Laboratory at New Orleans of the U. S. Department of Agriculture. He will be responsible for the scientific and administrative work of the division, which will involve research and development work to improve or modify by chemical treatment cotton fiber, cotton yarns, cotton textiles and cotton fabrics. Dr. Evald L. Skau, International Cancer Research Foundation fellow at Yale University, has been appointed senior chemist in the Oil, Fat and Protein Division of the laboratory. Dr. Skau's investigations will involve a study of various physical and chemical methods of separation of the fatty acids and glycerides, of cottonseed and peanut oils.

DR. ARLIE V. BOCK, Henry K. Oliver professor of hygiene at Harvard University, has been elected a member of the board of overseers of the Browne and Nichols School, Cambridge.

E. O. ESSIG, professor of entomology and entomologist of the Agricultural Experiment Station of the University of California, has been appointed advisory representative to the National Research Council from the Entomological Society of America. He also has become a director of the American Iris Society.

THE Committee on Scientific Research of the American Medical Association has made the following grants: To Dr. Wallace D. Armstrong, assistant professor of physiological chemistry at the University of Minnesota, to aid him in his work on the mechanism of the calcification process; to Dr. H. D. West, professor of biochemistry at Meharry Medical College, Nashville, Tenn., a renewal of the grant made last year for the continuance of his work on the synthesis of dl-threonine, and to Dr. H. P. Lankelma and Dr. B. S. Kline, of Western Reserve University, in aid of their work on the isolation of a substance in tissue extracts for use as antigen in tests for syphilis.

THE John and Mary R. Markle Foundation has appropriated a sum of $2,900 for an investigation of the viscosity of the blood to be carried out at Lafayette College under the direction of Professor Eugene C. Bingham. He continues the work begun a hundred years ago when Poiseuille made the first experiments leading to our knowledge of viscosity as a part of a study of the circulation of the blood.

THE Tuberculosis Institute of Chicago and Cook County, through the Theodore B. Sachs Memorial Fund, will support at the University of Illinois College of Medicine a study on bronchiectasis and pulmonary abscesses. This study, for which $1,000 is available, is being conducted by Dr. Felix Basch, of the department of pediatrics, and Dr. Paul H. Holinger, of the department of otolaryngology.

THE Elizabeth McCormick Child Research Grant of $1,000 for 1939–40 of the Institute of Medicine of Chicago will be used for the encouragement of research. Awards have been made to Dr. Mila I. Pierce for a program of research on leukemia; to Dr. Heyworth N. Sanford for a study of the role of the qualitative platelet factors in the coagulation of the blood, and to Dr. Clayton J. Lundy for a study of heart murmurs in children with rheumatic heart disease.

DR. A. A. BITANCOURT, sub-director of the Institute of Biology, São Paulo, Brazil, has completed a three-months official visit to the United States. He came as a delegate from the Brazilian Government to attend the third International Microbiological Congress held in New York from September 2 to 9. During his stay in the United States he visited various state agricultural experiment stations and colleges in Florida, New York, Wisconsin, Iowa, California and elsewhere, at some of which he made addresses on agriculture and plant pathology as related to Brazil. He also spent a month in Washington, conferring with members of the Department of Agriculture, and was for nearly two weeks at the Citrus Experiment Station, Riverside, Calif. On his way back to Brazil he planned to stop at Panama and several South American countries to make a study of citrus diseases.

DR. DENIS L. FOX, assistant professor of marine biochemistry at the Scripps Institution of Oceanography at La Jolla of the University of California, who has had a year's leave of absence as Rockefeller research fellow, has returned to the United States. He has been making a study at the University of Cambridge of pigments in lower plants and animals.

A DISCUSSION on "Science and the Press" will be held under the auspices of the New York chapter of

the American Association of Scientific Workers in the Engineering Societies Building, New York City, on November 17 at 8:15 P.M. The speakers announced are: Dr. Waldemar Kaempffert, science editor, *The New York Times,* and Dr. Leslie C. Dunn, professor of zoology at Columbia University.

DR. VICTOR G. HEISER, consultant for the Committee on Healthful Working Conditions of the National Association of Manufacturers, formerly director for the East of the International Health Board of the Rockefeller Foundation, spoke on November 2 before the Lancaster Branch of the American Association for the Advancement of Science. His subject was "Adventures in International Health."

DR. ELLICE MCDONALD, director of the Biochemical Research Foundation of the Franklin Institute, made a report on the work of the foundation at a stated meeting of the institute on the evening of November 15.

DR. JOHN T. AUTEN, silviculturist at the Central States Forest Experiment Station, spoke at the Iowa State College on October 24, at a meeting of Sigma Xi on "Forests and Soils" and on October 26, under the auspices of the Research Council, on "The Significance of the Physical Properties of Forest Soils."

DEAN B. E. LISCHER, of the School of Dentistry of Washington University (St. Louis), gave a course of lectures on the "Diagnosis of Dento-facial Anomalies" to graduate students of the School of Dental and Oral Surgery of Columbia University, during the week of November 6 to 11.

THE forty-first annual meeting of the American Physical Society will be held in Columbus, Ohio, on Thursday, Friday and Saturday, December 28, 29 and 30, in affiliation with the section of physics of the American Association for the Advancement of Science.

THE fourth annual meeting of the Carolina Geological Society was held at Spruce Pine, N. C., on October 21 and 22. B. C. Burgess, of Tennessee Mineral Products, Incorporated, was chairman of the local committee, which arranged visits to mines and plants in the region. About twenty-five members and forty-five guests were present. The pegmatites with their associated minerals and the kaolins were studied and discussed in the field. The following were elected officers for the coming year: *President,* Major J. H. Watkins, Charleston, S. C.; *Vice-President,* W. J. Alexander, Bryson City and Spruce Pine, N. C.; *Secretary-Treasurer,* Professor Edward Willard Berry, Duke University; *Chairman Membership Committee,* Professor J. J. Petty, University of South Carolina.

THE American Association for the Advancement of Science is desirous of obtaining for its annual exhibition, which this year will be held at Columbus, Ohio, exhibits of recent advances in the various fields of pure and applied science. Space will be provided for exhibits of special interest to members of the association attending the meeting. Applications should be made to the Director of Exhibits, 3941 Grand Central Terminal, New York, N. Y.

ANNOUNCEMENT has been made by the Finney-Howell Research Foundation, Inc., that all applications for fellowships for next year must be filed in the office of the foundation, 1211 Cathedral Street, Baltimore, by January 1. This foundation was provided for in the will of the late Dr. George Walker, of Baltimore, for the support of "research work into the cause or causes and the treatment of cancer." The will directed that the surplus income from the assets of the foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories and other institutions wherever situated, as may be approved by the Board of Directors." Fellowships carrying an annual stipend of $2,000 are awarded for the period of one year, with the possibility of renewal up to three years; when deemed wise by the Board of Directors, special grants of limited sums may be made to support the work carried on under a fellowship.

THE 1939 award for achievement in chemical engineering of the American Institute of Chemistry has been given to the Standard Oil Development Company "for its work in developing processes for the large-scale production of new aviation fuels and other synthetic chemical products from petroleum." The award was established in 1933 by *Chemical and Metallurgical Engineering.* It will be presented by the publishers to a representative of the company on December 4 at the opening of the national exposition of the chemical industries in the Grand Central Palace.

DISCUSSION

THE ALLOWED DIRECTIONS OF COSMIC RAYS AS AN EXISTENCE PROBLEM OF MATHEMATICAL ANALYSIS

IT is a wide-spread opinion and a matter of fact that the physicist may be interested only in an actual solution of a mathematical problem, whereas the question of the *existence* of a solution is without interest to him, for the existence of a solution may be always easily inferred from the physical meaning of the mathematical formulation of the problem.

In spite of this well-known fact, the theory of cosmic rays, as developed by Professor M. S. Vallarta,[1] provides a very clear example (and probably a first one) in which the question of the existence of a solution is the only one of interest. The knowledge of the conditions under which the solutions exist is here the only one way available for an experimental verification of the theory, whereas the solution itself—represented by the trajectory of an electrical particle coming from far cosmic regions—is beyond experimental means.

Let this statement be explained in more detail. The theory of cosmic rays, considered as a motion of charged primary particles, is ruled by a system of three ordinary differential equations of second order in three unknown functions (the coordinates of the particle) and one independent variable, the time t. The solutions of this system are trajectories of the particle, so that the problem appears to be a boundary problem, the boundary conditions being expressed by the values of three coordinates of the point P on the earth's surface, through which the trajectory passes, and by the infinite length of the radius vector for $t = \infty$. A fifth condition is given by the value of the energy of the particle, which is equivalent to the value of the velocity for instance at P. As a sixth condition, such a relation between the angles which the velocity vector in P forms with two fixed axes is required that a solution exists. This condition geometrically interpreted leads to the allowed cone[2] of Vallarta.

By means of the Lagrange's function the problem can be reduced to an extremum problem of the calculus of variations.[3]

The method with which Professor Vallarta solved the problem is an inductive one, based on an actual evaluation of the solutions. A direct method for the determination of the existence conditions is unknown, and perhaps there is no one example in the Mathematical Analysis, in which the existence and nonexistence conditions for a boundary problem are as completely known as is required by the theory of cosmic rays.

I. OPATOWSKI

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[1] See, for instance, the recent papers of M. S. Vallarta, "An Outline of the Theory of the Allowed Cone of Cosmic Radiation," The University of Toronto Press (1938) and "Present Status of the Effect of the Earth's Magnetic Field on Cosmic Rays," *Jour. of the Franklin Institute*, 227: 1, 1939.

[2] Actually there is another supplementary condition due to the fact that the earth acts as an impenetrable body. However, the first step in the solution of the problem is that related to the pure boundary conditions.

[3] T. Levi-Civita, *Archiv f. Mathem. og Naturvid.*, 31: 1911; and I. Opatowski, *Comptes Rendus*, 208: 638–640, 1939.

REVISION OF DENTAL SYMBOLS

UNDER this heading there appeared in the issue of SCIENCE for April 7 an article by E. S. Riggs. No doubt, Mr. Riggs's suggestions aid in simplifying the typographical complexity of dental formulae used in various stages of paleontological and anthropological representations. It seems to the present writer that Mr. Riggs's proposition is not exhaustive enough to meet all the exigencies of the situation.

In his inventories and literary work, the present writer has availed himself of a system of listing dentures and individual teeth which he gradually developed in long years of practice and study and which has proven satisfactory in anthropological use and, in its fundamentals, should be adaptable without difficulty to any branch of the reptilian or mammalian sciences.

In his system, then, teeth are recorded with regard to their denomination and state of preservation as well as to their presence or absence in the dentures of the upper and lower jaws. The method employed by the writer of accounting for the teeth in cataloguing or describing a special skull or series of skulls is by numbers, which holds for both the adult or permanent and the infantile or deciduous generation of teeth, when for the former he uses the Arabic, for the latter, the Roman characters. The two schemes following here represent the conditions mentioned:

Adult (permanent) dentition:

8	7	6	5	4	3	2	1	|	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	|	1	2	3	4	5	6	7	8

Infantile (deciduous) dentition:

V	IV	III	II	I	|	I	II	III	IV	V
V	IV	III	II	I	|	I	II	III	IV	V

The figures in these schemes account for the number and denomination of teeth in each jaw-half, namely, eight (8) in the adult and five (V) in the infantile. In cases of gradual replacement of the deciduous by the permanent teeth or by the addition of the gradually erupting molars, the infantile scheme is to be varied by the substitution or addition of Arabic numbers according to the individual status of the developing dentures.

Counting from the cranial, *i.e.*, dental midline to either side of the orientation conforms to general topographic concepts, the left sides of the schemes representing the right dental halves, and *vice versa*. Incisor teeth, then, in these schemes are enumerated as 1 and 2 (I and II); canines as 3 (III); premolars, corresponding to infantile molars, as 4 and 5 (IV and V), and the permanent molars as 6, 7 and 8.

Customarily the individual teeth of the dental generations and in each jaw-half are symbolized by initial letters, capitalized for the adult or permanent teeth and indicated by small letters for the infantile or deciduous teeth, and in addition to their serial numbers either above or below the line indicative of their posi-

tions in the upper and lower jaws. Thus, I^1 signifies an upper permanent first incisor tooth; Pm_2 a lower permanent second premolar; m^2 an upper second infantile molar (to be replaced by Pm^2 of the permanent generation), and so forth. Right and left furthermore may be signified either by an additional *r* or *l*, so that M_{1r} stands for a lower right first molar, i^{2l} for a deciduous upper left second incisor. The canine as of single occurrence in the jaw-half requires no enumerative marks, so that C^r stands for a permanent upper right, c_l for a deciduous lower left canine. Symbols like these are preferably used in the description of individual teeth, deciduous or permanent, fossil or recent.

As regards their state of preservation, individual teeth may either be non-erupted, lost, pathological or in process of eruption. The following list in a summarized form accounts for these features, as also for those described above:

1 – 8, indicating the permanent teeth of an adult jaw-half in mesiodistal orientation;
I – V, indicating the deciduous teeth of an infantile jaw-half in mesiodistal orientation;

I = incisor *C* = canine *Pm* = premolar *M* = molar	Symbols (capitalized initials) of permanent teeth
i = incisor *c* = canine *m* = molar	Symbols (small initials) of deciduous teeth

State of preservation of teeth in the dental schemes:

–, indicating non-eruption;
x, indicating post-mortem loss of tooth as shown by an empty alveolus, or a possible intra-vitam loss with a more or less obliterated alveolus or a more or less distinct gap remaining;
( ), indicating a pathological tooth, *e.g.*, (3);
○, a tooth in eruption, *e.g.*, (8).

Tentatively applying the last four symbols to the adult dental formula, the latter may individually occur as follows:

x x x x 4 3 (2) 1	1 2 3 (4) x 6 x 8
○ 7 6 x 4 3 2 1	1 – 3 4 5 6 7 ○

According to this formula and also using some of the other symbols, the state of dental preservation accounts in the right half of the upper jaw for a pathological I^{2r} and a missing Pm^{2r} and missing M^{1-3r}, in the left for a pathological Pm^{1l} and a missing Pm^{2l} and M^{2l}, while in the right half of the lower jaw Pm_{2r} is missing and M_{3r} in eruption, the left half accounting for a non-erupted I_{2l} and M_{3l} in eruption.

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POSSIBLE IMPLICATIONS OF REPTILIAN THERMAL TOLERANCE

INVESTIGATIONS into the thermal responses of the reptiles of southern California deserts have established a few facts that appear to be of particular interest since they suggest an alternative explanation for the sudden disappearance of their large Mesozoic predecessors.

The inhabitants of this extremely hot area show only moderate physiological adaptation to the maximum environmental temperatures to which they are subjected, achieving their survival largely through behavior in response to excessive insolation and heat.

The most heat-tolerant forms include the following diurnal lizards: *Sauromalus obesus, Dipsosaurus d. dorsalis, Uma notata, Phrynosoma platyrhinos* and *Phrynosoma m'callii.* These appear to be conspicuously thermophilous forms and yet, with ground-surface black-bulb thermometer readings as high as 87° C. common occurrences in their environment, they are characterized by optimum temperatures ranging between 37° C. and 38° C. The coastal lizards from appreciably cooler areas, *Phrynosoma b. blainvilii* and *Phrynosoma b. frontale,* as well as species from the higher or cooler desert areas, such as *Crotaphytus collaris baileyi, Crotaphytus wislizenii* and *Crotaphytus silus,* approach or equal these temperatures.

The most surprising fact relative to high temperatures is the characteristic reptilian inability to endure body heat much above the optimum, an increase of only 2° C. causing marked discomfort which seldom if ever will be tolerated voluntarily. Short exposures to higher temperatures cause death in from 60 seconds to an hour, the time element depending on ground heat, intensity of radiation, capacity for color change and volume of the lizard. Toward low temperatures these animals exhibit a far greater latitude, although 28° C. appears to be the lowest voluntarily tolerated temperature. These and other factors concerning the thermal relationships of desert lizards clearly suggest the possibility that high temperatures and increased insolation, rather than cold, may have been the chief element in bringing about the disappearance of the Mesozoic reptilian fauna, and it can be stated that if these forms were as notably susceptible to the lethal effects of high temperatures as our most heat-loving desert species of to-day, they could scarcely survive exposure to the direct sunlight of a hot summer day. Certainly it is notable that their successors were mainly homoiotherms or aquatic vertebrates, the terrestrial poikilothermous reptiles having disappeared with puzzling universality, especially from the viewpoint of encroaching low temperatures as the lethal agent.

In spite of our limited knowledge as to the actual density of vegetation during these important times it appears probable that exposure to direct sunlight was becoming increasingly unavoidable. The vegetational changes provide evidence of increasing aridity and suggest increasingly wide spacing of the trees and the

development of savanna types of country, presumably resulting in serious exposures of the larger reptiles at least, to almost direct untempered insolation.

Although no information is available it is probable that in common with the terrestrial poikilothermous vertebrates of to-day, the early Mesozoic reptiles may have relied upon a suffusion of melanin or other comparable heat-absorbing pigment for temperature regulation, a characteristic which appears to be of vital importance in the survival of desert lizards in order to achieve and control the body temperatures requisite for the normal functioning of physiological activities. The necessity for pigmentation by heat-absorbing substances would seem to have been particularly necessary if the commonly accepted concept of dense vegetation, heavy blanketing clouds and abundant water vapor existed on and above the earth's surface during Triassic, Jurassic and early Cretaceous times. With such pigmentation and lacking the capacity for color change, progressive reduction in the amount of water vapor or clouds would be accompanied by a disastrous rise in the body temperature of exposed reptiles. It is notable that desert snakes with no known capacity for color change are almost altogether either crepuscular, nocturnal or subterranean in habitat. The diurnal racers appear to survive excessive heat through their capacity for swift retreat to shade and in hot weather the trend is toward a crepuscular existence.

Additional evidence for progressively higher temperatures appears to be provided through the thermal evolutionary sequence as seen in the changes exhibited from the fishes to mammals and birds in which there is a distinct tendency toward the adoption of progressively higher body temperatures with an increasingly unfavorable susceptibility to cooling. This trend toward the optimum temperatures of complete homoiothermism and its perfection in the birds may reflect a gradual development in the environment of conditions feasible for the initial steps toward thermal control without excessive expenditures of energy due to internal-external temperature discrepancies, that is, in a gradual increase in available heat.

A much confused but apparently similar thermal-evolution relationship among plants is highly suggestive.

RAYMOND B. COWLES

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AT LOS ANGELES

SCIENTIFIC BOOKS

THE CARNEGIE INSTITUTION OF WASHINGTON AND DR. MERRIAM

Published Papers and Addresses of John Campbell Merriam. Publication No. 500, The Carnegie Institution of Washington.

Cooperation in Research. Publication No. 501, The Carnegie Institution of Washington.

MANY readers of SCIENCE doubtless noted with interest that Dr. John Campbell Merriam, president of the Carnegie Institution of Washington since 1921, had retired on December 31, 1938, in order that he might be free to devote his time to research and writing, and that the board of trustees of that institution, in appreciation of his far-sighted leadership, had appointed him president emeritus, with provision for the support of his studies.

Soon afterward the trustees also made arrangements for the publication of a testimonial volume to Dr. Merriam (Publication No. 501). Previously to this, the trustees had authorized the republication of the "Published Papers and Addresses of John Campbell Merriam"; this publication (No. 500) fills four large volumes, comprising 2,672 pages, an index, a bibliography and many illustrations. Both publications are of exceptional importance not only because they contain a great mass of valuable scientific and educational records and results, but also because they afford abundant evidence, direct and indirect, of the development of the Carnegie Institution itself under the influence of Dr. Merriam's far-reaching and constructive methods and philosophy.

Neither Dr. Merriam nor the Carnegie Institution could ever be fairly classed with those who learn "more and more about less and less"; they stand indeed at the opposite pole from that famous senior wrangler who gloried in the practical uselessness of his subject. Professor Chester Stock's appreciative article at the close of Publication No. 501 makes it clear that Dr. Merriam, a student all his life, has never ceased to extend and develop his first-hand knowledge of many sciences: botany, paleobotany, invertebrate paleontology, geology, vertebrate paleontology, archeology, anthropology and related fields; also that as an administrator he has gained such an insight into the methods and objectives of the physical sciences, history and philosophy that he has achieved far-reaching success in organizing and integrating the activities of many otherwise disconnected agencies in these diverse fields.

With this clue in hand we may thread our way with rising enthusiasm through the far-flung labyrinth of his scientific papers and addresses. However, the future historian who desires to study the earliest published writings of Dr. Merriam will be disappointed when he turns to the bibliography and reads the statement: "Not listed are several short articles between 1889 and 1891," which articles one would naturally

search for possible early indications of the trends which characterize Dr. Merriam's maturity. The first paper of Volume I is Dr. Merriam's doctorate thesis in the University of Munich: *"Ueber die Pythonomorphen der Kansas-Kreide."* This work by a young man of twenty-four is a finished piece of analysis, ending in an illuminating table of the contrasts of the three leading genera of American Cretaceous mosasaurs. It would do credit to a paleontologist of many more years of experience. At Munich he evidently found in his famous master, Professor Karl A. von Zittel, the clarity and precision in analysis and the insight that results in synthesis, which have always been the rocks upon which he has built. (We trust, by the way, that Dr. Merriam will not resent our analyzing him as he has analyzed his mosasaurs, ichthyosaurs and Tertiary mammals!)

The necessary limitations of space prohibit more than a mention of Dr. Merriam's papers (1895–1908) on the Triassic Ichthyosaurs of California and Nevada, culminating in his great monograph of 1908. This may safely be characterized as one of the major documents of vertebrate evolution and should be on the list of seminar discussions for all graduate students in that field. Regretfully we must pass over Dr. Merriam's intensive and extensive explorations and studies of the geology and paleontology of the John Day Basin of Oregon (Oligocene), of the late Tertiary and Pleistocene faunas of California, Nevada and Idaho (Vol. I and Vol. II in part) and his numerous papers on the Pleistocene mammalian fauna of the famous "tarpits" at Rancho La Brea, which the visitor to Los Angeles may now view both at Hancock Park and the Los Angeles Museum (Vol. II in part). Nor may we do more than refer to the "Tertiary Mammalian Faunas of the Mohave Desert," containing, with other papers in Volumes II and III, most important documents of mammalian evolution during the late Tertiary.

With his vast experience in the history of vertebrate and invertebrate life it was almost inevitable that Dr. Merriam should also take a special interest in the paleontological evidence bearing on the origin and emergence of man, especially in Western North America. All that may be said here is that he has succeeded, largely by direction of researches supported by the Carnegie Institution, in bringing to light much new evidence of the association of human artifacts of relatively advanced cultural stage with a mammalian fauna which has the aspect of late Pleistocene or early Recent provenience; the age of which in a recent memoir by Edgar B. Howard is tentatively estimated as of about 10,000 years. Thus Dr. Merriam's work tends strongly to confirm the relatively late arrival of man in America as compared with his history in Europe and Asia.

The fourth volume is devoted chiefly to Dr. Merriam's numerous addresses and papers relating to history, biography, problems relating to nature, research and publication, research and government, Carnegie Institution addresses and extracts from presidential Annual Reports.

When in 1936 Dr. Merriam was awarded the gold medal of the American Institute, the present writer referred to him as "both author and interpreter of an epic poem of unsurpassed grandeur. This poem is not written in verse but in the sober language of science. It is the epic of the history of vertebrate life on the Pacific coast, and the story is told in a long series of publications, chiefly in the bulletins of the Department of Geology in the University of California, but of late years also in the paleontological memoirs and papers of the Carnegie Institution of Washington. More than sixty localities scattered over California and the adjoining states have yielded the historical documents, in the shape of fossilized animal and plant remains, upon which this great epic has been built up."[1] With the fuller documents contained in Volumes I–IV of Publication 500 before us, the foregoing citation is seen to be even an understatement.

The volume "Cooperation in Research" (Publication 501), by staff members and research associates of the Carnegie Institution, comprises fourteen papers on the physical sciences, thirteen on the biological sciences, seven on history (mostly American archeology), five on paleontology and geology, three on philosophy and interpretation. In the first paper, entitled "An Adventure in Scientific Collaboration," Dr. Arthur L. Day, chairman of the Advisory Committee in Seismology, describes the large-scale cooperation between the Carnegie Institution as a whole and numerous other research foundations, the end being the development of the science of seismology from an "uninspiring status" to its present prominence and importance. During the course of this work the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, the Navy Department and other government agencies collaborated with various universities, observatories and geological societies of California, and their work was supported and endorsed by still another group of organizations. The results have contributed greatly to the knowledge, not only of earthquakes and their causes, but also of the physical properties of the successive zones of the interior of the earth, of the conditions under which the oceans and the continents are held in equilibrium, as well as those under which severe disturbances of the rock strata take place.

For cooperation on a smaller scale among the members of a special group, one may turn to the paper by

[1] *The Scientific Monthly*, 42: 4, 377–380, April, 1936.

the editor of the publications of the institution, Dr. Frank F. Bunker, on "Cooperative Research, Its Conduct and Interpretation." As an example of the fruitful results that may be obtained by the functional integration of a closely cooperating group, the editor selects the story of the activities of the Division of Plant Biology, under direction of Dr. H. A. Spoehr, in research on photosynthesis from the year 1911 through twenty-eight years.

Dr. Bunker explains the success of scientific research in our times as due to the same principle of cooperation. He writes:

> Again, as never before, there is team work among investigators who recognize neither national nor group boundaries. Neither are there "trade secrets" in scientific research. Progress reports are continually being interchanged among the workers throughout the world and thus each shares what he has learned with all the others; so, also, each borrows from others and builds upon what he borrows.
>
> An army of investigators, then, trained for the tasks, relieved of economic worry, supplied with every facility required, and working in tacit cooperation, accounts for the epoch-creating achievements now being made in the various fields of scientific research.

In the Year Book of the Carnegie Institution for 1934 Dr. Merriam wrote:

> As yet comparatively little attention has been given to the idea that science may have made its most noteworthy contribution through influences which aid in determining attitudes of mind and objectives. In other words, we have been concerned more largely with discussion of the extent to which science affects our environmental conditions than with the possibility that it helps to give us new points of view and a bettered attitude toward life. The great significance of this difference becomes apparent when we consider that influences determining point of view and attitude furnish major sources of human initiative, and are among the most important guiding elements in life.

These sentences take on new and startling aspects when we consider to what extent diverse points of view and attitude have determined conflicting human initiative within the past few months.

Thousands of people have doubtless gained a wider perspective and "a bettered attitude toward life" both from Dr. Merriam's own writings and from the numerous scientific and educational activities that have been sponsored by the Carnegie Institution under his guidance. Meanwhile "Cooperation in Research" affords a small-scale model of a cooperating society of diverse groups working in harmony, toward which a war-torn Europe may yet turn.

WILLIAM K. GREGORY

REPORTS

WORK OF THE CANADIAN NATIONAL RESEARCH COUNCIL

THE twenty-first annual report of the National Research Council has been issued. The work of the council falls naturally into two main divisions: the research investigations carried out in the laboratories at Ottawa, and the activities of the numerous committees that have been organized by the council to investigate specific problems and sometimes to plan and direct research which may be carried on in the universities or other institutions having special facilities for studies in certain subjects.

Special mention is made in the current report of the formation of the Associate Committee on Medical Research under the chairmanship of Sir Frederick Banting, co-discoverer of insulin. The method of forming this committee may be considered as typical. Preliminary discussions by representatives of the Canadian Medical Association, Royal College of Physicians and Surgeons, the Department of Pensions and National Health and the National Research Council resulted in the calling of a conference for the consideration of all matters relating to medical research in Canada. At this conference a composite picture of medical research was presented when each institution represented at the meeting reported on the scope of the researches on which it was engaged. On the recommendation of the conference the Associate Committee on Medical Research was formed.

Since then the correlation of medical research in Canada has been fostered through interchange of visits by research workers and group-planning of investigations in many fields. A distinct contribution to the furtherance of organized research in the medical field has thus been made.

Similar committees function under the council in many fields: aeronautics, asbestos, coal classification and analysis, field crop diseases, fire hazard testing, forestry, gas research, laundry research, leather, magnesian products, market poultry, metallic magnesium, parasitology, plant hormones, potato research, radio, radiology, survey research, weeds and wool.

In the laboratories there are four main divisions: biology and agriculture; chemistry; mechanical engineering, including aeronautics and hydraulics; and physics and electrical engineering. Supplementing these are a section on codes and specifications and the research plans and publications section. In addition there are the general administrative services necessary to such an organization.

Direction of the National Research Laboratories is vested in the president and all matters of policy are

ecided upon by the National Research Council, a ody of 15 men appointed on the recommendation of e Committee of the Privy Council for Scientific and dustrial Research, which in turn consists of seven embers of the Dominion Cabinet, presided over by e Honorable W. D. Euler, Minister of Trade and ommerce.

In the Division of Biology and Agriculture, the velopment of equipment for malting tests and for ld storage purposes has occupied an important place. evelopment of special equipment has enabled the lab- ratories to provide improved service to breeders of alting barleys. Efforts are being made to combine igh yield and disease resistance with the superior alting quality needed for enlarging the potential omestic and foreign market for Canadian barley.

The development of equipment to provide tempera- res as low as −40° F. in addition to ordinary storage uipment has simplified the study of cold storage of erishables. It is now possible to deal with produce the quick-freezing method, instead of allowing it radually to reach the temperature of storage. In operation with the industry a comprehensive study the whole system of curing and pickling bacon is nder way, with the object of improving the quality nd uniformity of the Canadian output.

Plants elaborate certain substances which, in very inute amounts, have profound effects on plant rowth. These have been referred to as "plant hor- ones." Efforts have been made to utilize these sub- ances as aids to plant growth by treating seeds with em. A method has been developed in the labora- ries in which the substance in very small amounts applied as a dust. By this means root development cuttings has been stimulated. Types of cuttings at foresters have found very difficult to root have sponded well to this kind of treatment. Experi- ents also indicate that improved germination, root velopment and growth of leafy parts may be at- ined when the seed or small growing plants are eated with dust. The substance is cheap, very inute quantities are needed, and since farmers al- ady use dust treatment for the control of fungi, the e of the hormone will involve little extra expenditure money or labor.

The Division of Chemistry has organized relations r research with the laundry and dry cleaning indus- y, the asbestos industry, the leather industry and, a less extent, with the wool manufacturing and gar industries. Much other work has basic indus- ial importance, *e.g.*, work on paints, rubber and extiles.

One of the most striking pieces of work of the last w years relates to the utilization of waste natural s. It has been found that by heat treatment in a furnace of a special but nevertheless simple design, the fraction of waste gas known as stabilizer gas can be made to yield three to four gallons of liquid motor fuel of the benzol type per 1,000 cubic feet of gas. The striking result has now been secured that the residual gas from such heat treatment will yield six to seven pounds of carbon black. This combination process seems to have attractive commercial possibilities.

A distillation column has been developed that is of great interest to the oil-refining, synthetic chemical and coal-tar industries, as well as to other industries using distillation as a process. Noteworthy results have been obtained in researches on starch. In the corrosion laboratory problems ranging from the corrosion of laundry hot water pipes to that of hydro-electric power dam gates are being investigated.

The work on magnesian products in the laboratories has been very profitable to Canada. The magnesian products laboratory has not only made available to the Canadian metal industry better refractories, and a greater range of them, but it has shown that these can be produced from Canadian materials. An investigation of various domestic barks as sources of tannin for the leather industry has been carried on in the leather laboratory. In the rubber laboratory much has been done on the bonding of rubber to metal, including particularly the application to the manufacture of automobile engine mountings of a bonding material previously developed in the laboratories.

In the Division of Mechanical Engineering there are available a wind tunnel for the testing of aeroplane models, streamlined locomotives and any other equipment in which air resistance is important, and a model-testing basin in which somewhat similar problems in regard to water may be investigated.

Five ship models have been tested during the year in the towing basin in connection with the design of private and government vessels. In two instances it was found possible to make major improvements in the propulsive characteristics. A one-hundredth scale model of a stop-log emergency dam was tested to ascertain the forces likely to be met in the operation of similar full-scale structures. Engines, aircraft instruments, gasoline and lubricating oils have been tested for various branches of the government service. Instruction is also given to members of the staff of the Royal Canadian Air Force in the testing, care and maintenance of the instruments used in their work.

In the division of Physics and Electrical Engineering, the normal fundamental phases of work on sound, light and heat, and the studies on electrical engineering are carried on concurrently with a steadily increasing amount of testing, examination and standardization of instruments. Advice has been given to a number of

government departments in connection with such varied matters as the acoustical treatment of rooms and buildings, apparatus for depth-sounding purposes, forest fire hazards, collection of insects and methods of plotting results of aerial surveys. In the metrology laboratory, apparatus for the precise calibration of standard gauges for industry has been designed and built. A satisfactory heater for use in refrigerator cars in winter to prevent freezing has been developed and is being taken up commercially. New apparatus has been installed in the electrical engineering laboratory to provide high-voltage current, and progress has been made in the precise regulation of voltage. Thousands of aircraft castings are being examined by x-ray methods and a 600,000-volt apparatus has been constructed to permit expansion of this work and for standardization of equipment for hospital use. Type approval of meters is being continued. The cathode-ray compass and direction finder, detection of fire through haze, estimation of forest fire hazard, vibration in aircraft, ultrasonic generators for depth sounding problems in camera design for air photography and spectroscopic analyses are some of the other matters under study.

Recent additions to equipment include an electric surge generator capable of developing a million volts for use in the testing of transmission line and other insulating material.

Radium preparations in large numbers are measured and certified in the radium laboratory. Recently a device for rapid testing of radium tubes for leakage was constructed and a method for measuring the radium content of barium-radium bromide preparations was developed.

SPECIAL ARTICLES

EFFECT OF ULTRA-SHORT RADIO WAVES ON PLANT GROWTH

A NUMBER of papers were published during the last few years on the effect of radio waves on plant growth. The results obtained were not quite clear, but in a few cases a definite stimulation of plant growth was observed after seeds or plants were radiated with ultra-short radio waves.[1]

The present article summarizes some of the results of our investigation of the effect of radiation of young corn seedlings with radio waves 2.5 m long.

The waves used were generated by a magnetron oscillator of about 25 watts of power, with a GE type FH 11 split anode magnetron in a conventional circuit.[2] The tube was operated with a DC plate voltage of 1,500 volts in an air solenoid with a magnetic field strength of about 750 gauss. The heating of the filament was such that the plate current was equal to 50 mA. The tank circuit consisted of a single loop of two parallel thin-walled copper tubings 3 mm in diameter and 32 cm long. These tubings were placed vertically 3.5 cm apart. Their lower ends were connected to the plate terminals of the magnetron, and their upper ends were short-circuited. At a distance of 3 cm above the plate terminals a condenser was connected to the tubings. It was made of two 1/16 inch copper strips 3 by 5.5 cm bent to form a split cylindrical condenser about 3.5 cm in diameter. The wave-length was determined with a Lecher system loosely coupled with the oscillator.

The following experimental procedure was followed. Corn seeds were germinated in moist sand in a physiological darkroom at 25° C and 90 per cent. humidity. After 2½ to 3 days the seedlings were dug out for treatment in a room illuminated with white light of moderate intensity. Radiation of the seedlings was accomplished by placing the shoot (excluding the seed and roots) between the plates of the condenser on a strip (7 mm wide and 2 mm thick) of "Victron," a material which shows a very slight absorption of the waves used. The controls were treated exactly like the experimental plants, with the exception of the exposure to the short waves. After radiation the seedlings were planted in moist sand and put back in the darkroom, where they were kept for the duration of the experiment.

Various exposures were tried. Those of 60 seconds and longer usually destroyed the upper part of the mesocotyl, which became limp immediately after treatment and the seedlings died. Exposures of about 10 seconds turned out to be too short to produce any appreciable effect. Therefore the exposures of between 20 and 30 seconds were used in the experiments.

The results of these experiments did not demonstrate any stimulation of growth. To the contrary we found that the waves used produced, at least as far as our seedlings were concerned, a markedly reduced growth of the first internode,[3] whereas the growth of the coleoptile was far less affected.

It was discovered a few years ago by one of us[4] that

[1] G. Murray McKinley, "Biological Effects of Radiation," pp. 541–558. McGraw-Hill, 1936; K. v. Oettingen, *Strahlentherapie*, 41: 251–285, 1931; S. Sasada, *Nippon Elect. Comm. Engin.*, 7: 295–297, 1937; A. Denier, *Proc. Intern. Congress for Short Waves*, Vienna, 1937: 320–322.

[2] Complete description in General Electric pamphlet GEJ–239A; see also E. D. McArthur and E. E. Spitzer, *Proc.* IRE.,19: 1971–1982, 1931.

[3] The shoot of the seedlings of grasses consists of the first internode or mesocotyl and above it the coleoptile which envelops the primary leaf.

[4] J. van Overbeek, *Rec. trav. bot. neerl.*, 33: 333–3[illegible] 1936.

e growth of the first internode of young seedlings of ize can be considerably reduced if they were kept in electric oven at 48° C for 30 minutes. It was own at that time that this effect of reduction of owth depends upon the decrease in auxin (growth rmone) production due to heat treatment. The xin is produced in the coleoptile tip and controls e growth of the first internode. Thus a decrease in xin production could account for the decreased owth of the internode. This conclusion was proven perimentally when it was shown that the applica- n of synthetic auxin (indoleacetic acid) immediately ter the heat treatment made the internode grow nor- lly again.

The present investigation similarly disclosed that ants having a reduced growth of the first internode, e to ultra-short wave radiation, had a reduced auxin oduction (See Table 1). The auxin production was

TABLE 1

MOUNT OF AUXIN, IN DEGREES OF CURVATIVE IN THE AVENA TEST, GIVEN OFF DURING HOURLY PERIODS BY 10 COLEOPTILE TIPS. THE TEST WAS MADE 20 HOURS AFTER THE SEEDLINGS HAD BEEN EXPOSED FOR 20 SECONDS (80929).

	Radiated	Controls
First Hour	6.3	11.5
Second Hour	3.5	6.9
Third Hour	1.9	6.5
Length of mesocotyl (mm)	34.6	44.8

termined by means of the diffusion method.[5]

In a number of cases additional auxin was applied radiated plants. This was done with a paste of doleacetic acid in lanolin applied to the tip of the edlings immediately after the radiation. As experi-

TABLE 2

NGTH (IN MM) OF THE COLEOPTILE (C) AND THE MESOCOTYL (M) OF CORN SEEDLINGS AFTER RADIATION WITH AND WITHOUT AUXIN TREATMEN . AVERAGES OF ABOUT 40 PLANTS (81007), (80924).

	Time of exposure (sec)	Auxin concentration per cent.	Time after radiation (hours) 24 C	24 M	48 C	48 M	72 C	72 M
diated, no xin applied	20	..	11.2	13.0	20.3	30.8	...	...
	30	..	...	...	...	...	40.7	35.6
t radiated, o auxin applied	..	..	13.3	17.2	26.2	39.8	45.9	53.0
diated, auxin pplied	20	.02	12.8	25.0	20.0	50.3	...	...
	30	1.0[6]	...	...	...	...	53.3	45.6

nts showed (see Table 2) such application of addi- nal auxin restored the first internode to normal.[7]

[5] J. van Overbeek, *Plant Physiol.*, 13: 587–598, 1938.

[6] An indoleacetic acid concentration of 1 per cent. rned out to be too high, causing the internodes to swell ther than to elongate.

[7] Both control plants and experimental plants were ex- sed to light when brought in the radiation room. The duction in growth caused by exposure to light is also set by auxin application.

From these results it follows that, at least under the condition of our experiments, the effect of ultra-short radio waves on young corn seedlings can be accounted for as a heat effect.

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BIO-ELECTRIC POTENTIALS OF THE HEN'S EGG

THE possibility of detection of vital activity of the blastoderm of fertile eggs by physical means was suggested by Waller.[1] Also it was tried by Vorontzov and Serguijevski[2] to measure the electrical potential through the shell, between the top and the bottom of the egg on the equatorial plane. They observed that 3 to 4 hours incubated eggs gave an electro-potential difference of about 0.5 millivolt and 20 hours' incubation about 1.0 millivolt. But fresh eggs were almost isopotential, or electro-potentials were very small. Owing to that fact it is still a question whether there is a difference in electrical potentials in fresh fertile and infertile eggs. In an attempt to answer that question the present study of bio-electric potentials of the opened hens' eggs was undertaken.

The procedure followed was to apply a pair of physiological saline solution capillary electrodes to the opened egg. One electrode was touching the albumen several millimeters beyond the yolk, while the other electrode successively was placed on the top of the yolk in contact with points at various distances from the center of the blastoderm. To insure more intimate contact on the exposed surface of the yolk, the albuminous sac of the thick middle layer was ruptured and moved aside.

Potential differences existing between the electrodes were measured by a vacuum tube microvoltmeter similar to one described by Burr, Lane and Nims.[3] However, the circuit used by us was somewhat modified from that of Burr *et al.* A duotriode 6C8G tube was used with a pair of parallel filament resistances forming the grid biases close to floating grid potentials to partially offset A battery fluctuations. The input grid was brought accurately to floating grid potential by an additional C battery potentiometer control and the input was then applied across 10 megohms between the grid and ground.

[1] A. Waller, "Signs of Life." London, 1903.

[2] B. S. Vorontsov and M. V. Serguijevski, "L'electrophysiologie de l'oeuf de poule." Probleme der Tierzsucht No. 6, Moscow, 1933 (in Russian).

[3] H. C. Burr, C. T. Lane and L. F. Nims, *Yale Jour. Biol. and Med.*, 9: 65–76, 1936.

The electrodes proper were of Ag-AgCl prepared as described by Brown[4] and were constant to several microvolts during a run. The capillary electrodes were so arranged that fresh saline solution formed the contact for each measurement. Checks of the inherent electrode potential differences were made before and after each reading.

The sensitivity of the voltmeter and electrodes was slightly above 100,000 mm/volt with a wall galvanometer. Measurements were made inside a wire screen cage to reduce pick-up disturbances. Room temperature varied less than 2° F. from day to day. Fresh eggs having been collected from the nests in the morning were brought into the room and allowed to come to room temperature for at least four hours before being measured. Several groups of measurements were delayed until the following day and were found somewhat higher than those made on the day the eggs were collected.

The incubated eggs were measured immediately after having been removed from the incubator and opened. While being measured the eggs were close to the incubating temperature, which was maintained by a thermostatically controlled enclosure.

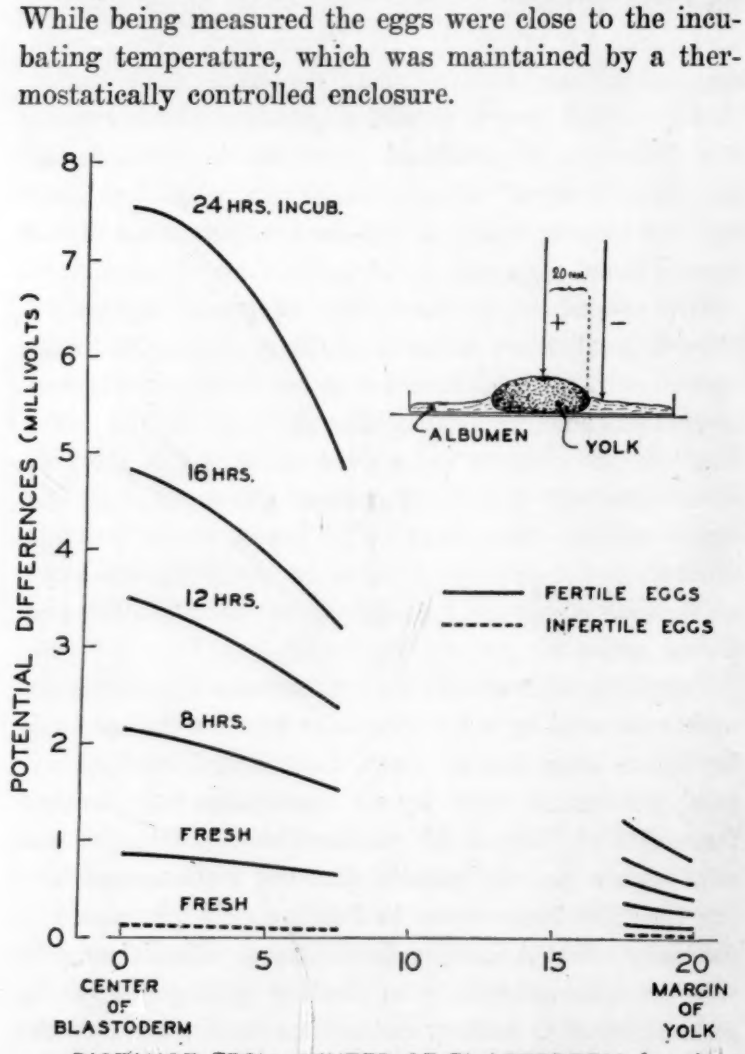

FIG. 1. The general trend of electrical potential differences of fresh and incubated eggs. One electrode was touching the albumen, while the other electrode was in contact with yolk at various distances from the center of the blastoderm.

[4] A. S. Brown, *Jour. Am. Chem. Soc.*, 56: 646–647, 1934.

The results of these observations are graphically shown in Fig. 1. There was evident an increase in potential differences with incubation, which was several times greater than through the shell.[2] On the same egg the differences decreased as the contact was moved away from the blastoderm, though some differences were still indicated at the margin of the yolk.

Most significantly in these measurements differences in electrical potential were found between fertile and infertile fresh eggs. Fertile eggs showed on an average of about 0.8 millivolt difference in potential, while with infertile eggs the difference averaged less than 0.2 millivolt.

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IMPLANTS OF EMBRYONIC TISSUE INHIBIT PARTURITION IN THE RAT

MASAO[1] described a tumor-like teratoma which he produced in mice by the inoculation of embryonic tissue. Histologically these tumors appeared to be identical with naturally occurring teratomata. The writer has subjected numerous albino rats to this procedure in the last two years. The production of these artificial teratomata is very simple. Rat fetuses about 15 days old were crushed fine enough so that the tissues could be passed through a gauge 18 hypodermic needle. A little mammalian ringer solution was added, and about 2 cubic centimeters of this material was injected into the visceral cavity. Care was taken to complete the operation as rapidly as possible. So far the embryonic tissue implanted in this manner has continued to grow in every instance. The rate of growth is rather slow. A weight of 3 to 12 grams has been attained at the end of one year.

Recently seven females 11 months of age which had carried these teratomata for six months were bred to a normal male. Their response was normal in every way except that parturition was inhibited. The fetuses developed normally, attaining the maximum size which the placentae allow and then died unless removed by hysterotomy. This experiment has been repeated on a group of ten females, and the same results were obtained.

It has been noted, however, that the implant of embryonic tissue must have had time to develop to a certain degree before parturition is completely inhibited. One rat with this implant present was able with difficulty to achieve the birth of her young. The same animal six weeks later was unable to evacuate the uterus. At the latter period the implant of embryonic tissue weighed 1.1 grams.

[1] *Jap. Jour. Cancer Res.*, 22: 28, 1928.

In his review of the factors concerned with the duration of pregnancy Snyder[2] has pointed out that parturition is under endocrine control. King[3] and others have shown that an extract of pregnancy urine will prolong the gestation period in the rat. It has been known for some time that urine from women afflicted with certain tumors such as hydatidiform mole and chorionepithelioma reacts positively in pregnancy tests. Also urine from men suffering from teratoma of the skin of the testes gives positive results in this test. It would seem, then, that these embryonic implants also secrete a chemical substance which is similar to the prolan contained in pregnancy urine, and as a result the presence of this tissue in the body affects the gestation period in the same manner as the injection of pregnancy prolan.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ARRANGEMENT OF APPARATUS FOR THE ISOLATION OF MONOCHROMATIC LIGHT OF HIGH INTENSITY AT λ, 254 mμ[1]

WHEN monochromatic light is isolated by a monochromator, focal isolation or an optical train using filters, the light available for photochemical work represents only a small fraction of the total light produced by the source at that wavelength. This has been overcome sometimes by placing the actinic system, to be studied, in a vessel which surrounded both the light source and a suitable filter. Such an ensemble, however, requires that the volume of the actinic system be large unless the absorbing layer is made unduly thin. Sometimes the filter has been dispensed with and the actinic system allowed to contact the light source; but then, temperature control has been troublesome. The arrangement of apparatus given in Fig. 1 overcomes some of these difficulties by working in from the light source—in this case, a mercury "resonance" lamp. Any other source, however, may be used if it operates in a similar environment.

The lamp was constructed of quartz tubing coiled cylindrically like one previously used at M. I. T. to produce Raman spectra.[2] It differed from that lamp by having the axis of the coil parallel to the electrodes rather than perpendicular to them. This modification permitted the lamp to operate in a conducting liquid, such as water, with the axis of the coil vertical and the electrodes dry. Stray light from the tubing extending beyond the coil was eliminated by wrapping these parts in aluminum foil. The coil consisted of four complete turns of 1 cm tubing, which formed a cylinder 7 cm i.d. and 8 cm high. The electrodes were iron cylinders coated with a mixture of the carbonates of Ba, Ca and Sr. These carbonates were subsequently decomposed by being heated in a vacuum with an induction furnace, followed by flushing the red-hot electrodes and quartz tubing with a discharge through hydrogen. The cold lamp was then filled with argon at a pressure of 1 cm of mercury, and after introducing about half a gram of mercury the lamp was sealed while a discharge was passed through. It was lighted by a transformer rated to deliver 120 milliamperes at 5,000 volts when connected to a 110-volt A. C. line. The leads from the secondary were made as short as possible and were well insulated.

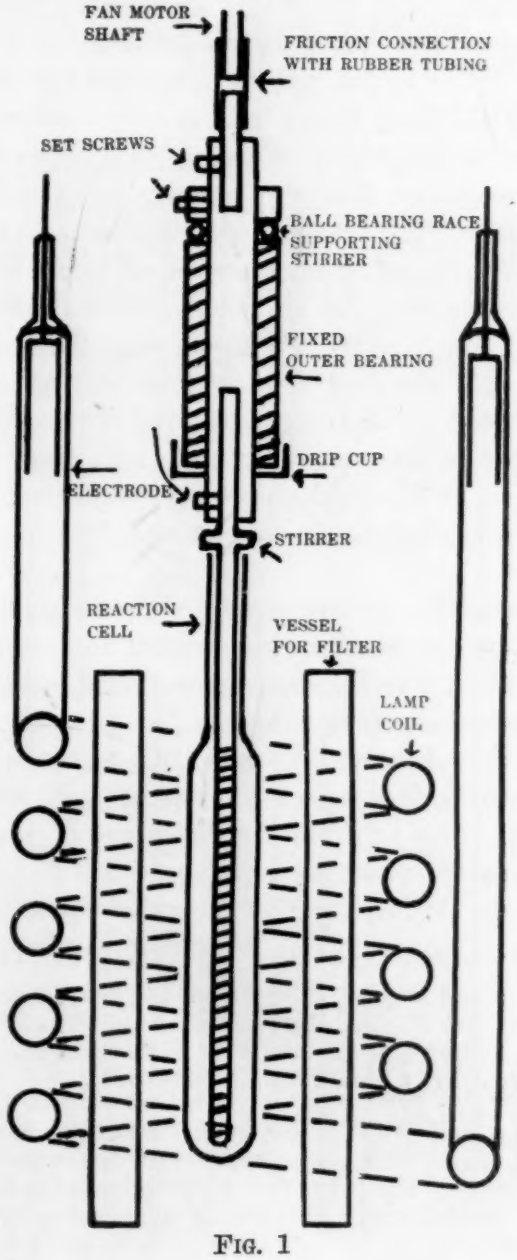

FIG. 1

[2] *Physiol. Rev.*, 18: 578, 1938.

[3] *Am. Jour. Physiol.*, 122: 455, 1938.

[1] Contribution from the Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, No. 430.

[2] Harris, Ashdown and Armstrong, *Jour. Am. Chem. Soc.*, 58: 852, 1936.

Within the lamp coil was centered a cylindrical quartz vessel (3.5 cm i.d. and 10 cm high), which contained between its walls a 1 cm layer of dry chlorine at 1 atmosphere. This layer of chlorine absorbed 94 per cent. of 297 and 366 mμ and even more of the light between these wave-lengths.[3] Glacial acetic acid (reagent quality) was discolored when it was used as a filter for several days and then absorbed strongly λ, 254 mμ. It was not improved when refluxed over chromic anhydride (reagent quality) and then distilled in vacuum.

The system to be illuminated was placed in a quartz reaction cell centered on the axis of the light filter, so that the lamp light could reach the cell only by passing through the filter.

The lamp reached equilibrium with its surroundings after it had been lighted half an hour. When it was stopped momentarily to introduce a new cell, equilibrium was reestablished by relighting the lamp ten minutes before illuminating the photo-sensitive system. Subsequent fluctuations in the light intensity then remained within less than 5 per cent. over at least twenty hours.

Ultra-violet light reaching the reaction cell was over 95 per cent. of λ, 254 mμ, as observed from spectrograms of the light before and after it traversed the layers of chlorine and water. Other observations[4] have shown that a mercury resonance lamp emits light which is over 82 per cent. of λ, 254 mμ. When the lamp was operated in air, an odor of ozone was produced by light at λ, 185 mμ and shorter wave-lengths;[5] but the 2 cm layer of water, between the lamp and reaction cell, absorbed this light as well as most of the infrared.[6] Visible light reaching the reaction cell usually can be ignored by properly adjusting the concentrations of the light-absorbing species when their extinction coefficients are greater at λ, 254 mμ than in the visible.

The light flux was measured with the dilute solutions of uranyl oxalate recommended for use as actinometers.[7] These solutions were stirred with a thin ribbon of transparent quartz in the form of a screw turning at more than 500 r.p.m. Care was taken not to let a large fraction of the actinic light reach the stirrer in order to avoid the difficulties of evaluating corrections for scattered light, particularly when the reaction under investigation depended upon the light intensity. To realize this the stirrer was kept half a centimeter from the part of the cell wall holding the solution. Here, the cell was 1.3 cm i.d. and 8 cm long; one end was fuzed shut and the other end was fuzed to 6 cm of .7 cm quartz tubing to minimize evaporation of the actinic solution. The volume of the solution, in this case, happened to be 11 cc, but smaller or larger volumes also would have intercepted the light fluxes given below, merely by changing the diameter of the cell and, if necessary, that of the stirrer. A light-proof aluminum tube that slipped over the cell acted as a shutter. The temperature was controlled by regulating the temperature and rate of flow of the air or water surrounding the lamp, filter and the reaction cell.

When the ensemble was used in air, 5×10^{19} photons of λ, 254 mμ were incident per minute on the actinometer; in distilled water there were 4×10^{19} photons; and in running Cambridge tap water 10^{19}. These values of the light flux in air and distilled water are over two hundred times greater than the light flux that has been obtained at λ, 254 mμ from a monochromator.[8] The light intensity was diminished further, when desired, by surrounding the filter with a wire gauze of the proper mesh, and could be increased by winding the lamp coils closer together and surrounding them with polished aluminum or some other suitable mirror.

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[3] Gibson and Baylies, *Phys. Rev.*, 44: 188, 1933.

[4] Avery and Forbes, *Jour. Am. Chem. Soc.*, 60: 1006, 1938; and Cline and Forbes, *ibid.*, 61: 716, 1939.

[5] Flory, *Jour. Chem. Phys.*, 4: 23, 1936.

[6] I. C. T., 5: 271.

[7] Forbes and Heidt, *Jour. Am. Chem. Soc.*, 56: 2363, 1934. A more sensitive actinometer that can be used advantageously for very low light intensities has been studied carefully by Harris and Kaminsky, *ibid.*, 57: 1154, 1935.

[8] Forbes and Brackett, *Jour. Am. Chem. Soc.*, 53: 3973, 1931.

Errata: In the article by Dr. H. Waelsch and Dr. D. Rittenberg entitled "The Metabolism of Glutathione," printed in the issue of SCIENCE for November 3, the last line on the second column on p. 423 should read "6 mg" of copper glutathione instead of "16 mg."

In the article by Drs. Casimir Funk and Ian Casimir Funk printed in the issue of SCIENCE for November 10, on p. 445, the last line of Table V, "I" Stilbestrol should read "II" Stilbestrol.

BOOKS RECEIVED

EVE, A. S. *Rutherford.* Pp. xvi + 451. Illustrated. Macmillan. $5.00.

LOWENBERG, MIRIAM E. *Your Child's Food.* Pp. ix + 299. Illustrated. Whittlesey House, McGraw-Hill. $2.50.

MCMINN, HOWARD E. *An Illustrated Manual of California Shrubs.* Pp. ix + 689. 775 figures. J. W. Stacey, Inc., San Francisco. $5.00.

Storrs Agricultural Experiment Station. *Studies of Suburbanization in Connecticut; 3, Wilton; a Rural Town Near Metropolitan New York,* by NATHAN L. WHETTEN. Pp. 132. 19 figures. Connecticut State College.

TWENHOFEL, W. H. *Principles of Sedimentation.* Pp. v + 610. 44 figures. McGraw-Hill. $6.00.

WHITTLESEY, DERWENT. *The Earth and the State; a Study of Political Geography.* Pp. iii + 618. 85 figures. Holt. $3.75.